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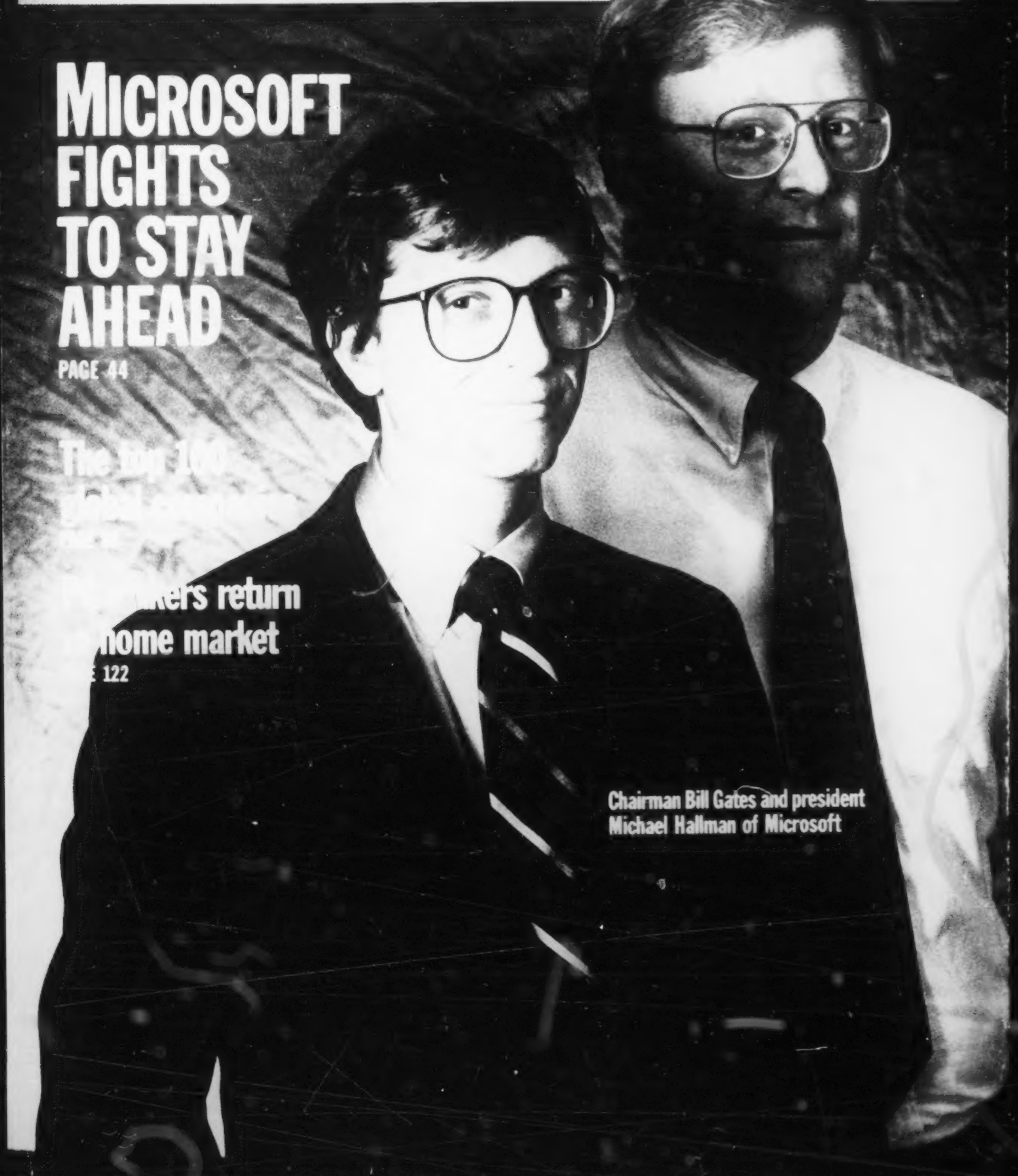

MICROSOFT FIGHTS TO STAY AHEAD

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Chairman Bill Gates and president
Michael Hallman of Microsoft

Electronic Business

FOR MANAGEMENT IN ELECTRONICS, COMPUTER AND SYSTEMS COMPANIES—WORLDWIDE

VOL. 16, NO. 21

NOVEMBER 12, 1990

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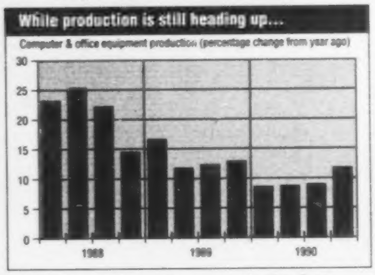

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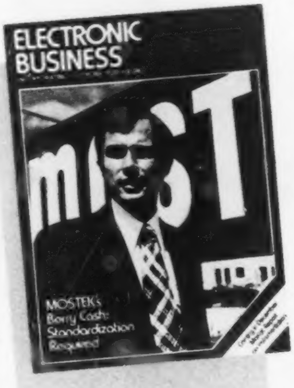
Perspective: a rare quality



Things change, and in the electronics and computer industries the changes come with lightning speed. The pace of change makes this kind of journalism fun, but it also can make it hard to gain perspective, especially if one wants that perspective to include the entire 15 years (as of this issue) that ELECTRONIC BUSINESS has been published. Fortunately, we can call on consulting editor Alberto Socolovsky to provide that broad perspective, as he does in his commentary: "15 years of Electronic Business."

Alberto was this magazine's editor during most of the 1980s. When he was asked to take the job by Vic Drumm, the first ELECTRONIC BUSINESS publisher, he was already a veteran of the electronics industry, having worked as an engineer, editor, and market researcher. He had witnessed the birth of the companies that led development of integrated circuits, minicomputers, and microcomputers.

Alberto recalls, "Like Berry Cash [the Mostek exec whose photo graced our first cover] and like Ralph Waldo Emerson, with his 'better mousetrap,' I believed that new technology automatically created new markets, that all you had to do was come up with technologically advanced new products and your sales were guaranteed. And, why not? That's exactly what was happening with the Department of Defense market."

Then came the military budget cuts of the early 1970s, followed by a recession (sound familiar?). Alberto says that, as an editor of a magazine that soon became a victim of that recession, "I began to wonder for the first time how the technology I was writing about was going to provide jobs for my readers."

Alberto calls his arrival at ELECTRONIC BUSINESS a case of being in the right place at the right time. In the early 1980s, the magazine chronicled a period of unsurpassed growth for the electronics industry, thanks largely to the rise of personal computing and advances in communications technology. Alberto left the magazine as a full-time editor in 1988 to start his own company, marketing an expert system developed by his daughter and her husband.

Combining business and electronics in one magazine was considered a radical move back in 1975. "The electronics industry of the 1990s calls for even more of a business magazine than in '75," says Alberto. "Particularly, it calls for a magazine with a worldwide outlook." Given Alberto's unique perspective, we consider that sound advice.

JOHN W. PARKER, section editor

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Vital signs: How the U.S., Europe, and Japan compare

	Electronic revenues ($ billions)	Total consolidated revenues ($ billions)	Net income before tax as a percentage of revenues	Net income after tax as a percentage of revenues	Return on equity	Return on investment	Revenues per employee	Net income before tax per employee
North America	275.6.	586.1	8.7%	5.5%	13.3%	6.9%	$136,384	$11,867
Europe	129.3	277.7	6.9%	4.2%	13.6%	7.5%	$102,383	$7,068
Asia	209.4	317.0	6.3%	3.5%	9.4%	4.9%	$171,788	$10,844
International 100	614.3	1,180.7	7.6%	4.6%	12.3%	6.5%	$133,346	$10,184

All data is weighted averages except electronics and total revenues
- Some companies do not have complete data

The Electronic Business International 100

ELECTRONIC BUSINESS introduces its first annual financial list of the 100 largest international electronics corporations

BY BRUCE C.P. RAYNER AND LINDA STALLMANN

The term "global" has been overused. All industries—but electronics in particular—have become global out of necessity. The impact of internationalization on the corporation (namely changing corporate structures and market strategies) will challenge executives into the next century. Today's leading international companies are taking the first steps toward confronting these issues.

Who are these leading companies? According to the first annual ELECTRONIC BUSINESS listing of the largest 100 electronics companies in the world, almost three-quarters make their home in either the United States or Japan. Britain and Germany, each with five companies, are the nations with the next largest numbers of electronics world leaders.

Christopher Bing

In terms of electronics revenue, North American companies—46 from the United States and 1 from Canada—account for 45% of the electronics-related revenue of these top 100 companies. The 30 Asian companies on the list represent 34% of the total, while the 23 European companies account for the remaining 21%.

In terms of profits, again it is North American companies that lead the pack. In total, North American companies made $51 billion before taxes, compared with $20 billion for Asian companies and $19 billion for European companies. However, not one Asian company—27 of the 30 Asian companies on the list are Japanese, the other 3 are South Korean—reported losses last year. Six of the 8 companies on the list that lost money last year were U.S.-based; the other two were European.

Not surprisingly, IBM, with close to $63 billion in

	Fixed assets per employee	Investments as a percentage of revenues	R&D as a percentage of revenues	Capital expenditures as a percentage of revenues	Capital expenditures to net cash flow after dividends	Percentage of total capital	Current ratio
	$46,568	14.5%	5.9%	8.5%	100.5	48.0%	1.34
	$29,848	14.2%	6.6%	7.5%	89.3	44.6%	1.60
	$62,729	13.6%	4.9%	8.7%	105.2	47.7%	1.40
	$44,814	14.2%	5.8%	8.4%	97.3	47.3%	1.43

Source: ELECTRONIC BUSINESS

electronics-related revenue last year, towers over its electronics brethren. Even second-ranked Matsushita Electric Industrial Co. is less than half the size of Big Blue in terms of revenue and not nearly as profitable. Also in terms of investment—both for capital equipment expenditures and R&D—IBM reigns supreme with $13.2 billion, seconded by Japan's Nippon Telephone and Telegraph with $10.4 billion. Ford Motor Co. runs a close third with $9.9 billion.

But consider the statistics for the top 10 companies on the list: Of the $238 billion in electronics revenue that these giants generated last year, the 6 Japanese companies in this group represent almost half the total top-10 revenue. What's more, it is Asian companies that excel in terms of productivity.

In Asia, revenue per employee, a measure of productivity, averages $35,000 above the U.S. average and $70,000 above the average in Europe. While the productivity rates of the United States and Japan appear to be slowly converging (see the Oct. 29 issue of ELECTRONIC BUSINESS), the degree of difference remains sizable.

Likewise, assets per employee—a measure of automation and a determinant of productivity—is much higher in Japan than in either the United States or in Europe. And the ratio of capital expenditures to net cash flow, a measure of capital regeneration, is higher in Japan than in both the United States and Europe.

Regional averages, while important for determining broad trends, often mask individual company achievements. For example, of the top five most productive companies on the list, four are U.S.-based. The top company in terms of revenue per employee, with a phenomenal $400,790, is Japan's Casio Computer Co., ranked 80th in total revenue. Next in the revenue-per-employee category is Apple Computer Inc. (#34 in total revenue), Compaq Computer Corp. (#55), Amdahl Corp. (#75), and DuPont (#68). ☐

The ELECTRONIC BUSINESS International 100 is an exclusive report by ELECTRONIC BUSINESS magazine on the 100 largest publicly held international computer and electronics manufacturers. The listing was derived by analyzing company financial statements, 10-K reports, and annual reports, as well as through executive interviews and estimates by the editors.

Notes to the top international electronics companies

Electronics revenue: Represents ELECTRONIC BUSINESS' estimate of the revenue earned by each company from the sale of electronics products. The figure shown is based on the latest fiscal year, thus a variety of accounting periods are represented.

Similarly, the electronics revenue and other financial data have been translated to U.S. dollars using various exchange rates based on the companies' fiscal years

Net income: Net income is income from continuing operations and before extraordinary items

Return on equity: ROE is net income after taxes as a percentage of shareholders' equity (preferred stock, capital stock, surpluses, and retained earnings at the company's year-end)

Return on investment: ROI is net income after taxes as a percentage of shareholders' equity, plus short-term debt and long-term debt. Short-term debt includes the current portion of long-term debt, notes payable and other borrowings

Fixed assets per employee: Shows the accumulated value (less depreciation) of land, building, plant and machinery, furniture and fittings (including rental equipment) that the company has invested per employee

Investments as a percentage of revenue: Adds together capital expenditures (new investments in fixed assets) and research and development expenses (company-sponsored) as a percentage of revenue

Capital expenditures to net cash flow after dividends: Capital expenditures are measured as a percentage of net income after taxes from continuing operations plus depreciation, minus cash dividends paid

Debt as a percentage of total capital: This includes long-term debt and short-term debt as a percentage of shareholders' equity plus long- and short-term debt

Current ratio: Shows current assets as a proportion of current liabilities, giving a rough indication of the liquidity of the company

Country of origin: Indicates the country in which the company is ultimately registered

Source: ELECTRONIC BUSINESS

Electronic Business

Electronic Business International 100

Rank	Company	Electronics revenues ($ millions)	Total consolidated revenues ($ millions)	Net income before tax as a percentage of revenues	Net income after tax as a percentage of revenues	Return on equity	Return on investment	Revenues per employee
1	**IBM**	$62,710	$62,710	10.6%	6.0%	9.8%	6.8%	$163,640
2	**Matsushita**	27,313	37,992	9.5%	3.9%	7.4%	4.3%	191,591
3	**NEC**	21,799	21,799	5.0%	2.5%	10.6%	4.1%	190,216
4	**Philips NV**	21,078	26,992	2.2%	1.4%	4.1%	1.6%	88,558
5	**Siemens**	20,290	32,659	4.6%	2.6%	8.5%	6.9%	89,477
6	**Toshiba**	19,107	26,911	6.3%	3.1%	12.1%	4.6%	189,515
7	**Hitachi**	17,900	44,797	7.5%	3.0%	8.2%	4.4%	154,472
8	**AT&T**	16,586	36,112	11.1%	7.5%	21.2%	11.6%	127,379
9	**Fujitsu**	16,138	16,138	NA	3.4%	NA	NA	140,330
10	**Sony**	14,760	18,227	7.9%	3.6%	7.2%	3.5%	190,658
11	**NTT**	13,800	38,116	8.7%	4.3%	6.3%	3.1%	139,669
12	**CGE**	13,247	22,572	5.3%	3.4%	18.1%	8.7%	107,333
13	**Digital Equipment**	12,742	12,742	11.1%	8.4%	13.3%	13.1%	101,287
14	**Xerox**	12,431	12,431	8.2%	3.9%	8.0%	2.9%	125,566
15	**Hewlett-Packard**	11,899	11,899	9.7%	7.0%	15.2%	11.4%	125,253
16	**GM Hughes Electronics**	11,359	11,359	8.7%	5.6%	8.0%	7.2%	124,824
17	**Thomson**	11,184	12,026	2.2%	0.6%	4.0%	1.2%	120,190
18	**Unisys**	10,097	10,097	-5.5%	-6.3%	-16.5%	-8.1%	122,684
19	**Motorola**	9,620	9,620	6.7%	5.2%	13.1%	9.3%	92,500
20	**Mitsubishi Electric**	9,400	18,838	NA	2.6%	NA	NA	211,395
21	**General Electric Co.**	8,920	40,987	13.9%	9.6%	18.9%	14.8%	140,366
22	**Canon**	8,400	8,550	6.7%	2.8%	7.0%	3.4%	192,566
23	**General Electric Co. plc**	7,370	14,153	9.9%	6.2%	23.3%	18.1%	87,362
24	**Sharp**	7,100	8,658	NA	3.0%	NA	NA	141,240
25	**Robert Bosch**	6,615	16,277	6.6%	2.0%	9.4%	7.3%	93,150
26	**Olivetti**	6,586	6,586	3.9%	2.2%	5.6%	2.2%	115,669
27	**Texas Instruments**	6,522	6,522	5.4%	4.5%	11.7%	9.3%	88,308
28	**BCE**	6,095	14,086	13.4%	7.2%	12.6%	6.4%	117,386
29	**Honeywell**	6,059	6,059	11.2%	9.1%	28.7%	20.0%	83,399
30	**NCR**	5,956	5,956	12.4%	6.9%	20.8%	16.2%	106,357
31	**Sansung**	5,954	5,954	5.0%	4.0%	22.1%	7.8%	138,457
32	**Ericsson**	5,534	6,129	8.1%	4.7%	16.7%	11.5%	88,536
33	**Raytheon**	5,333	8,796	8.6%	6.0%	21.8%	14.5%	113,351
34	**Apple Computer**	5,284	5,284	14.1%	8.6%	30.6%	29.4%	363,988
35	**Groupe Bull**	5,133	5,133	-0.5%	-0.8%	-4.6%	-1.6%	117,678
36	**Rockwell International**	5.029	12,797	9.4%	5.7%	18.5%	13.9%	117,715
37	**Sanyo**	4,428	8,643	3.4%	1.2%	2.4%	1.2%	155,658
38	**Ricoh**	4,400	5.288	3.7%	1.9%	4.6%	3.0%	142,912
39	**STC**	4,269	4,269	10.7%	6.8%	27.0%	21.8%	117,298
40	**Eastman Kodak**	4,200	18,398	5.0%	2.9%	8.0%	3.1%	133,561
41	**Tandy**	4,181	4,181	12.6%	7.7%	18.1%	15.3%	110,019
42	**Oki**	3,987	3,987	4.7%	2.6%	9.1%	3.2%	206,247
43	**Lockheed**	3,830	9,891	-0.4%	0.1%	0.3%	0.2%	119,891
44	**Nokia**	3,589	5,627	2.6%	1.2%	8.7%	2.2%	136,247
45	**3M**	3,297	11,990	17.5%	10.4%	23.1%	18.5%	136,897
46	**Litton Industries**	3,265	5,023	6.3%	3.5%	14.1%	6.1%	99,069
47	**Pioneer**	3.239	3.239	12.5%	5.8%	10.1%	8.4%	233,028
48	**Martin Marietta**	3.188	5.796	7.4%	5.3%	22.7%	16.7%	88,491
49	**Intel**	3.127	3.127	18.6%	12.5%	15.3%	12.5%	144,094
50	**TDK**	3.024	3.024	10.7%	4.9%	7.0%	4.8%	136,329

NA = Not available

Net income before tax per employee	Fixed assets per employee	Investments as a percentage of revenues	R&D as a percentage of revenues	Capital expenditures as a percentage of revenues	Capital expenditures to net cash flow after dividends	Debt as a percentage of total capital	Current ratio	Fiscal year ended	Country of origin
$17,340	$65,088	21.1%	10.9%	10.2%	122.3	30.3%	1.65	12/89	United States
18,248	30,565	11.5%	5.8%	5.8%	79.1	41.2%	1.77	3/90	Japan
9,595	52,894	27.0%	16.1%	11.0%	139.6	61.5%	1.14	3/90	Japan
1,961	28,779	13.5%	8.0%	5.5%	74.8	60.6%	1.58	12/89	Netherlands
4,080	20,348	18.0%	11.2%	6.7%	81.3	18.6%	3.20	9/89	Germany
12,022	40,363	15.1%	6.3%	8.8%	103.2	62.4%	1.25	3/90	Japan
11,567	37,296	15.4%	6.1%	9.3%	312.0	46.3%	1.63	3/90	Japan
14,081	56,152	21.8%	7.3%	14.5%	109.4	45.3%	1.25	12/89	United States
NA	NA	NA	NA	NA	NA	NA	NA	3/90	Japan
15,057	57,474	17.1%	5.7%	11.3%	128.6	50.9%	1.10	3/90	Japan
12,157	225,677	27.4%	4.1%	23.3%	84.7	51.5%	0.78	3/90	Japan
5,682	18,137	12.3%	7.5%	4.8%	73.4	52.1%	1.52	12/89	France
11,293	28,982	21.6%	12.0%	9.6%	69.5	2.0%	2.88	6/89	United States
10,283	10,586	10.0%	6.5%	3.5%	48.2	63.7%	NA	12/89	United States
12,116	30,453	17.9%	10.7%	7.2%	71.1	25.0%	1.53	10/89	United States
10,854	32,877	10.9%	5.2%	5.7%	77.9	10.4%	1.41	12/89	United States
2,634	17,724	11.3%	5.5%	5.9%	138.6	70.2%	1.22	12/89	France
-6,735	22,543	13.8%	7.7%	6.1%	-166.3	50.5%	1.44	12/89	United States
6,212	32,087	19.5%	8.1%	11.4%	104.3	28.8%	1.42	12/89	United States
NA	NA	NA	NA	NA	NA	NA	NA	3/90	Japan
19,531	53,582	8.7%	3.3%	5.4%	55.7	21.3%	NA	12/89	United States
12,985	43,085	12.0%	5.6%	6.4%	91.1	51.0%	1.69	12/89	Japan
8,671	10,620	12.3%	9.6%	2.8%	46.0	22.6%	1.66	3/90	Britain
NA	NA	NA	NA	NA	NA	NA	NA	3/90	Japan
6,190	15,311	12.6%	5.9%	6.7%	94.2	21.9%	2.46	12/89	Germany
4,545	20,731	10.4%	5.3%	5.1%	133.5	60.2%	2.43	12/89	Italy
4,804	28,837	21.0%	7.8%	13.2%	133.1	21.0%	1.88	12/89	United States
15,728	121,678	25.2%	6.0%	19.1%	152.3	49.5%	0.94	12/89	Canada
9,304	16,366	9.1%	4.7%	4.4%	38.2	30.4%	1.16	12/89	United States
13,196	19,714	14.6%	7.5%	7.1%	69.0	21.9%	1.49	12/89	United States
6,889	49,452	21.1%	NA	21.1%	117.3	64.7%	1.05	12/89	South Korea
7,215	17,408	17.7%	10.9%	6.8%	102.5	31.4%	1.80	12/89	Sweden
9,764	18,767	7.8%	3.1%	4.7%	62.2	33.6%	1.10	12/89	United States
51,272	23,023	12.5%	8.0%	4.5%	45.2	3.7%	2.56	9/89	United States
-633	32,340	18.2%	9.0%	9.2%	123.7	65.9%	1.50	12/89	France
11,090	23,862	18.0%	13.3%	4.8%	58.6	24.9%	1.25	9/89	United States
5,308	53,069	11.3%	4.9%	6.4%	111.3	51.1%	1.41	11/89	Japan
5,310	31,238	12.4%	6.0%	6.4%	99.4	35.1%	1.48	3/90	Japan
12,506	20,541	17.3%	10.4%	6.9%	80.2	19.2%	1.35	12/89	Britain
6,715	62,635	18.3%	6.8%	11.5%	175.6	60.7%	1.31	12/89	United States
13,879	11,072	2.9%	NA	2.9%	35.5	15.7%	3.41	6/89	United States
9,657	53,221	17.0%	6.3%	10.7%	95.4	64.4%	1.52	3/90	Japan
-485	23,067	9.1%	5.1%	4.0%	150.6	47.6%	1.17	12/89	United States
3,610	32,103	10.9%	5.1%	5.9%	117.7	75.0%	1.53	12/89	Finland
23,966	42,325	16.4%	6.5%	9.9%	83.2	19.9%	1.98	12/89	United States
6,204	8,911	[illegible]	5.4%	5.0%	65.2	56.4%	1.81	7/89	United States
29,061	39,609	9.7%	3.9%	5.8%	62.8	16.8%	2.17	3/90	Japan
6,555	19,862	8.2%	3.3%	4.9%	62.9	26.2%	1.56	12/89	United States
26,867	59,173	25.2%	11.7%	13.5%	67.2	18.2%	2.35	12/89	United States
14,648	51,236	14.4%	5.2%	9.2%	84.4	31.2%	2.23	3/90	Japan

Source: ELECTRONIC BUSINESS

Electronic Business

Electronic Business International 100

Rank	Company	Electronics revenues ($ millions)	Total consolidated revenues ($ millions)	Net income before tax as a percentage of revenues	Net income after tax as a percentage of revenues	Return on equity	Return on investment	Revenues per employee
51	**Ford Motor**	$3,017	$82,879	7.3%	4.6%	16.9%	3.5%	$226,076
52	**Control Data**	2,935	2,935	-22.8%	-23.2%	-165.3%	-86.1%	163,028
53	**Allied-Signal**	2,900	11,942	5.8%	4.4%	15.5%	9.1%	111,503
54	**ITT**	2,888	20,054	6.2%	4.6%	11.4%	5.6%	168,521
55	**Compaq Computer**	2,876	2,876	16.8%	11.6%	28.4%	22.6%	302,743
56	**TRW**	2,870	7.340	5.4%	3.6%	15.0%	8.0%	98,789
57	**Wang Laboratories**	2,869	2.869	-9.2%	-11.2%	-28.4%	-15.3%	98.247
58	**Goldstar**	2,863	3.922	1.1%	0.7%	3.5%	1.0%	118,855
59	**Westinghouse Electric**	2,783	12.844	9.9%	7.2%	21.0%	6.2%	105,311
60	**British Telecom**	2.775	19.837	18.7%	12.3%	16.4%	10.5%	80,018
61	**AEG**	2,767	6,516	2.5%	2.2%	13.5%	9.6%	83,831
62	**Asea Brown Boveri**	2,680	20,560	4.4%	2.9%	15.1%	5.9%	108,500
63	**Omron**	2,634	2,634	10.5%	4.7%	9.1%	6.0%	166,490
64	**Alps**	2,549	2,549	1.9%	0.2%	NA	NA	76,622
65	**Boeing**	2,420	20,276	4.5%	3.3%	11.0%	10.5%	127,362
66	**AMP**	2,377	2.797	16.3%	10.0%	17.3%	14.7%	114,616
67	**Kyocera**	2,321	2.665	17.0%	8.0%	7.4%	6.3%	88.825
68	**DuPont**	2,300	35.534	12.2%	7.0%	15.7%	10.4%	243,739
69	**Harris**	2.214	2.214	7.6%	5.2%	12.3%	6.6%	63.067
70	**Emerson Electric**	2.213	7,071	13.5%	8.3%	19.1%	15.4%	97,401
71	**Nippondenso**	2,203	8,248	9.9%	7.4%	7.4%	6.1%	166,997
72	**Seiko**	2,200	2,670	NA	0.4%	NA	NA	166,875
73	**GTE**	2,140	17,424	11.8%	8.1%	16.9%	7.0%	110,281
74	**Pitney Bowes**	2,120	2,876	9.1%	6.3%	12.6%	4.3%	91,571
75	**Amdahl**	2,101	2,101	12.1%	7.3%	13.0%	11.7%	256,234
76	**Fiat**	2.075	36,741	10.2%	6.6%	20.7%	10.8%	128.332
77	**Grundig**	2,062	2.062	3.9%	3.9%	16.4%	15.9%	99.521
78	**Nintendo**	2.022	2,022	26.7%	11.8%	21.8%	21.8%	NA
79	**Memorex Telex**	1,983	1,983	-1.6%	-3.0%	NM	NM	204.470
80	**Casio**	1.929	1.929	5.1%	2.5%	NA	NA	400.790
81	**Bayer**	1,913	23,041	9.5%	4.9%	13.2%	10.6%	135,377
82	**Racal Electronics**	1,861	3,179	10.2%	5.9%	14.0%	8.9%	84,975
83	**Citizen**	1,800	2,117	6.6%	2.9%	7.3%	NA	126,972
84	**Daewoo**	1,779	7,117	5.6%	4.5%	24.1%	10.3%	NA
85	**Sun Microsystems**	1,765	1,765	4.4%	3.4%	9.2%	6.6%	172,939
86	**Minolta**	1.759	2,199	NA	1.1%	NA	NA	199.901
87	**Avnet**	1,709	1,934	4.5%	2.8%	7.3%	5.7%	227,474
88	**McDonnell Douglas**	1,650	14,589	-0.8%	-0.3%	-1.1%	-0.5%	114,042
89	**National Semiconductor**	1.648	1.648	-12.0%	-12.5%	-24.2%	-22.6%	51.177
90	**Ferranti International**	1,642	1,642	1.4%	0.7%	5.8%	2.0%	66,870
91	**Tandem Computers**	1,633	1,633	11.4%	7.2%	12.0%	10.2%	170,981
92	**Matra**	1,584	3,465	4.8%	2.7%	12.4%	4.6%	163,103
93	**Murata**	1,568	1,568	16.8%	7.7%	NA	NA	74,667
94	**Italtel**	1,568	1,568	NA	5.2%	NA	NA	93,541
95	**Zenith Electronics**	1,549	1,549	-1.1%	-1.1%	-4.3%	-2.9%	48,403
96	**Matsushita Electric**	1.500	5.644	NA	3.6%	NA	NA	NA
97	**Yokogawa**	1.500	1.524	7.4%	4.4%	NA	NA	NA
98	**Schlumberger**	1.500	4.686	11.3%	9.0%	14.5%	11.9%	101,869
99	**E-Systems**	1.463	1.633	7.3%	5.1%	14.8%	12.4%	91,124
100	**Tektronix**	1,433	1,433	4.0%	1.3%	3.8%	2.5%	91,227

NA = Not available NM = Not meaningful

Net income before tax per employee	Fixed assets per employee	Investments as a percentage of revenues	R&D as a percentage of revenues	Capital expenditures as a percentage of revenues	Capital expenditures to net cash flow after dividends	Debt as a percentage of total capital	Current ratio	Fiscal year ended	Country of origin
$16,447	49,469	12.0%	3.8%	8.2%	112.8	79.0%	0.95	12/89	United States
-37,128	16,161	10.9%	8.5%	2.4%	-13.0	47.9%	1.51	12/89	United States
6,499	31,008	9.6%	5.0%	4.5%	79.1	41.1%	1.28	12/89	United States
10,395	29,899	5.8%	2.8%	3.0%	51.7	51.3%	NA	12/89	United States
51,004	74,261	17.4%	4.6%	12.8%	88.0	20.6%	2.33	12/89	United States
5,370	26,299	9.6%	3.5%	6.2%	81.0	47.1%	1.28	12/89	United States
-8,997	31,897	18.9%	8.5%	10.4%	-360.0	45.9%	1.37	6/89	United States
1,302	41,211	16.3%	4.7%	11.5%	198.5	70.2%	1.10	12/89	South Korea
10,454	19,522	4.7%	1.4%	3.3%	44.4	70.4%	1.02	12/89	United States
14,957	96,041	27.1%	1.9%	25.3%	118.1	35.7%	0.74	3/90	Britain
2,102	NA	12.3%	6.4%	5.9%	92.2	28.9%	1.76	12/89	Germany
4,808	21,357	10.4%	6.6%	3.8%	77.9	60.9%	1.24	12/89	Switzerland
17,546	46,997	16.0%	6.2%	9.8%	103.7	33.7%	1.89	3/90	Japan
1,493	NA	NA	NA	NA	NA	NA	NA	3/90	Japan
5,791	21,866	10.4%	3.7%	6.7%	131.8	4.4%	1.30	12/89	United States
18,659	39,088	18.1%	9.0%	9.0%	75.7	14.9%	1.98	12/89	United States
15,100	26,547	12.1%	4.4%	7.6%	65.0	14.8%	3.68	3/90	Japan
29,660	129,477	16.0%	3.9%	12.1%	107.6	33.6%	1.21	12/89	United States
4,762	17,554	9.2%	4.7%	4.5%	50.2	46.1%	1.24	6/89	United States
13,140	16,497	7.1%	3.1%	4.0%	50.3	19.5%	1.86	9/89	United States
16,484	114,317	17.9%	7.1%	10.8%	77.8	17.6%	2.22	12/89	Japan
NA	NA	NA	NA	NA	NA	NA	NA	12/89	Japan
13,064	150,001	20.1%	1.6%	18.5%	106.4	58.7%	0.98	12/89	United States
8,313	35,205	13.5%	3.0%	10.4%	102.3	65.9%	0.75	12/89	United States
31,119	65,086	27.7%	13.2%	14.5%	114.4	10.0%	2.02	12/89	United States
13,074	35,260	10.4%	3.6%	6.8%	64.6	48.0%	1.37	12/89	Italy
3,915	18,057	10.1%	4.0%	6.1%	67.6	3.4%	1.60	3/90	Germany
NA	NA	2.8%	NA	2.8%	24.6	0.0%	2.05	8/90	Japan
-3,256	20,971	2.2%	1.3%	0.9%	56.4	106.9%	1.44	3/90	Netherlands
20,415	NA	NA	NA	NA	NA	NA	NA	3/90	Japan
12,835	38,088	14.2%	6.2%	8.0%	92.6	19.6%	2.46	12/89	Germany
8,670	30,466	18.2%	4.1%	14.1%	161.1	36.6%	1.24	3/90	Britain
8,356	NA	NA	NA	NA	NA	NA	1.47	3/90	Japan
NA	NA	2.3%	NA	2.3%	46.0	57.0%	1.19	12/89	South Korea
7,642	28,800	24.9%	13.3%	11.6%	125.1	28.7%	1.90	6/89	United States
NA	NA	NA	NA	NA	NA	NA	NA	3/90	Japan
10,264	12,496	1.2%	NA	1.2%	34.3	22.5%	5.48	6/89	United States
-938	20,699	8.2%	4.2%	4.0%	224.7	60.0%	NA	12/89	United States
-6,165	21,630	32.9%	16.1%	16.8%	-901.3	6.8%	1.51	5/89	United States
944	18,060	7.2%	NA	7.2%	226.8	66.2%	1.17	3/89	Britain
19,515	46,856	20.8%	12.5%	8.3%	58.9	14.3%	1.96	9/89	United States
7,797	31,325	8.2%	2.0%	6.1%	90.4	63.0%	1.49	12/89	France
12,564	NA	NA	NA	NA	NA	NA	NA	3/90	Japan
NA	NA	16.7%	10.5%	6.2%	182.7	NA	NA	12/89	Italy
-525	6,781	5.5%	3.3%	2.2%	145.1	32.3%	1.89	12/89	United States
NA	NA	NA	NA	NA	NA	NA	NA	11/89	Japan
NA	NA	NA	NA	NA	NA	NA	NA	3/90	Japan
11,537	35,822	18.9%	7.2%	11.7%	83.8	18.2%	1.41	12/89	Netherlands
6,615	13,100	5.6%	2.1%	3.5%	53.5	16.4%	3.27	12/89	United States
3,650	21,929	19.2%	13.2%	6.0%	111.2	33.2%	1.54	5/89	United States

Source: ELECTRONIC BUSINESS

Connector makers buffeted by shifting market factors

In Asia, U.S. companies find their traditional market shares changing. Market leaders Molex and AMP stalk each other across the region

BY JOEL MCCORMICK

Connector makers large and small are dropping like flies in the $16 billion worldwide market, despite industry growth last year of 9%. Record merger and acquisition activity in 1988 doubled in 1989, a trend that is not expected to slow anytime soon.

If they are not gobbling each other up to acquire technology, connector companies are buying wider patches of geography to keep up with customers' shifting of production lines to lower-cost sites in the Americas, Europe, and Asia. The pressure to capture lucrative geography is expected to quicken the merger pace.

Because it is the low-cost manufacturing center, the Asian market is where much of the attention is today. Connector market growth in Pacific Rim countries, where more and more company fortunes are being won or lost, has averaged more than 12% in recent years, twice the U.S. rate. Excluding Japan, the Asian market accounts for a little more than 6% of the world connector market, according to market researcher Fleck International of Huntington Beach, Calif.

While there are an estimated 800 connector companies in the world, predictions are that the number of players could drop to only 100 by the end of the decade. "That makes good headlines," says Ken Fleck, president of Fleck International. By his count, there were 19 mergers or acquisitions in 1987, 21 in 1988, and 42 last year.

The biggest player to be acquired recently was Norwalk, Conn.-based Burndy Inc., the U.S. stalwart founded in 1924, which was taken over by France's Framatome Connector International and joined to FCI's Jupiter and Souriau lines—also buy-outs. Like Amphenol Corp., which is part of LPL Technologies, Burndy continues to operate under its own name.

Connector making is a huge, engineering-intensive business with inordinately little clout. It makes critical components but, with few exceptions, they account for 2% or less of the product's value.

That alone allows customers to call the shots in all sectors—whether military, automotive, telecom, computer, or consumer. "We follow our customers," Molex Inc.'s people say proudly. If they didn't, they'd be as dead as the television and appliance industry that used to fan out from the Chicago area where Molex was born 51 years ago.

The customer is also responsible for forcing consolidation. Apple Computer Inc. started to cut back on its connector suppliers in the early '80s, and the practice is gaining adherents. Hewlett-Packard Co., for instance, wants to cut back its connector suppliers, now numbering more than 30. How far back? "I've heard to five," Fleck says. Customers want to harness all the spread-out spending power—which can run to more than $100 million in HP's case—and concentrate on a small number of connector makers in order to reduce prices and speed delivery.

AMP's William Yiu says Taiwan must upgrade product quality

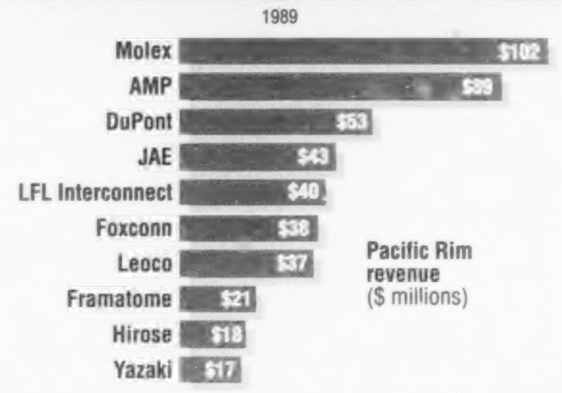
The Burndy acquisition was done partly to satisfy customers like HP. Framatome ended up with both new technology and wider global reach. It bought a place in Asia, the latest surface-mount technology, and expertise in highly prized half-pitch connector products that Burndy pioneered.

But Asian factories are not always a sure bet, as Amphenol discovered. The company set up its Asian manufacturing base to make flat cable and insulation displacement connection (IDC) connectors in Hong Kong in 1985 when labor was available and inexpensive and the colony boasted a solid infrastructure.

Today, explains East Asia Amphenol marketing director Bob Ko, labor availability is in a decline and hardly cheap. Hong Kong's infrastructure is also being badly shaken by the anxiety over the People's Republic takeover of Hong Kong in 1997.

Burndy's regional general manager John Siena admits Hong Kong's changing situation gives him pause. "I'm considering the options," he says. "Right now, I'm sitting on the fence." Burndy still operates as a regional headquarters, even if local sales are only puttering along in Hong Kong's post-Tiananmen Square melancholy.

Top 10 Pacific Rim interconnect suppliers



Source: Electronic Business Asia

With company coffers fattened with Framatome cash, Burndy is moving more quickly. Siena says the company is considering setting up a new plant elsewhere, possibly in Malaysia or Indonesia. Plans are being drawn up on the heels of last year's opening of Burndy's Taiwanese production base.

Japan Aviation Electronics Corp. (JAE), Japan's top player in Asia's Pacific Rim grouping, has moving headaches of its own. Marketing manager Daniel Wong at Hong Kong Ryosan Ltd., JAE's exclusive agent in the colony, says factory location is one of his biggest problems in meeting customers on price.

"Japanese production costs are so much higher," Wong says. Even a depreciating yen hasn't helped much, he says. JAE tried to trim costs by moving some production to Taiwan, but the island's fast-rising currency has made the move all but self-defeating, according to Wong.

Computer slump

There is general agreement that the downturn in the U.S. economy and the flat computer industry isn't going to help any of the struggling connector makers. "Technology has gone beyond what people can digest," says Amphenol's Ko. As a result, most customers are trying to consolidate the technology they have without buying a lot of new products.

Even as the computer industry slows, there is strength in Asia's consumer market, some insiders say. "Japan is very hot," says Molex Japan's marketing director, Yasuhiro Ichijo. He remembers the days when Japan had only a half-dozen domestic connector companies and not the 40-plus he has to contend with now.

Acknowledging Molex's position as fifth in Japan's overall connector sales, Ichijo still insists, "We're number one in the consumer market. AMP Inc.'s weak point is that it has to defend its position across the whole market—automotive, data, and consumer sectors."

Ichijo figures Molex occupies a very strong position. "Our customers are making more radio cassette recorders with CD players, more camcorders, more VCRs. These products have many more connectors because the circuitry is complex," he explains. That means Molex ends up selling higher-value devices and many more of them.

Despite a flat computer market, Burndy's Siena is upbeat. "I expect the PC market will soon come alive," he says. That opens up business for Burndy's range of IBM Micro Channel and Extended Industry Standard Architecture bus connectors. And while it is waiting, Burndy can deploy marketing troops in other areas. "I'm excited about telecom in China and Korea and opportunities in the industrial [automation] area," Siena says.

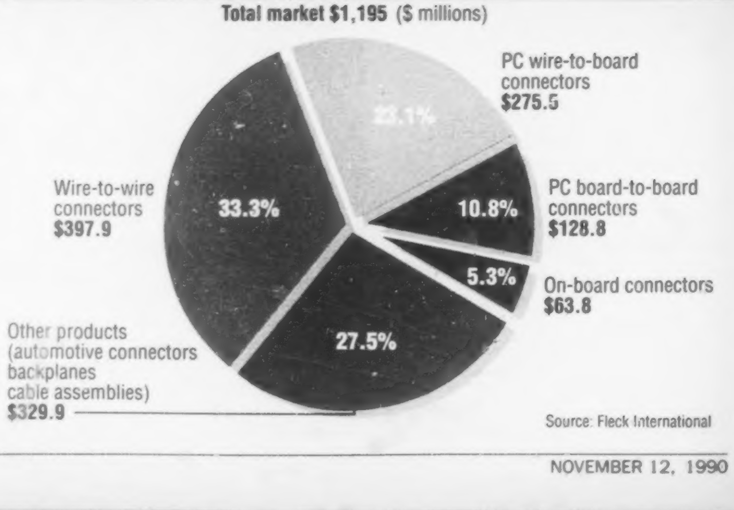
Meanwhile, JAE waits out the current computer slump, caused to some degree by Intel Corp.'s delay in shipping 80386 chip sets as well as the general downturn in the U.S. economy. Ryosan's Wong refused to hazard sales projections for JAE connectors in Hong Kong.

Is he encouraged by all the talk about a boom in network products as computer users start to consolidate their computer base? Not really. "People have been talking about networks for a long time," Wong says.

Foxconn, Taiwan's largest connector maker and sixth-ranked in the Pacific Rim, faces leaner times, too. Kok Chiu, sales manager at Hong Kong's Bestronic Industrial Co., which serves as Foxconn's exclusive agent in the colony, says the company hopes to achieve 8.5% growth this year, only half of last year's growth. Chiu says the company is banking on an upturn in the U.S. economy that should see growth return to double digits by 1991.

But AMP's regional marketing manager William I.S. Yiu cautions it may not be smooth sailing for Taiwan connector companies even if the U.S. economy bounces back. He says Taiwan's computer companies will have to shift to higher-quality components, connectors included, if they hope to earn mid- and top-end

Connector sales in Pacific Rim/Asia by product



Source: Fleck International

product status.

Molex-Nanco Ltd.'s managing director, Don Davies, sees opportunities—although not an abundance of them in Hong Kong—with generally rising corporate demand for network products and increased vendor demand for the higher-density products Molex can make. Declining to offer projections on Molex regional fortunes for 1990, Davies says only that he expects the company to exceed the industry average.

Molex opened its China operation near Hong Kong, a joint venture with Dongguan Tong Da Industries, just after the country started going to pieces in the aftermath of last year's Tiananmen Square massacre. But there has been a surprisingly good recovery, Davies says. "We're budgeting for growth. Of course, the operation is in its infancy."

Still, fallout from the massacre rattled Hong Kong, sending electronics makers on the prowl for new sites in Malaysia, Thailand, and elsewhere. Molex, though, has little to lose on this score because it can sell connectors to migrating companies from practically anywhere. The company has Asian operations in Japan, Taiwan, South Korea, Hong Kong, China, Singapore, Malaysia, Thailand, and India.

Marketing director Bob Ko at Amphenol: "Technology has gone beyond what people can digest"

"Our worldwide organization is of particular interest to multinational customers as they look for suppliers throughout the world," said Molex's founding chairman John Kriehbiel, Sr. in his 1989 report to shareholders.

In these turbulent times, Asian leaders Molex and AMP have adopted different approaches to managing their global businesses. Molex, with almost three-quarters of its volume generated offshore, is of the "you-know-best" school with its network of "largely autonomous" affiliates. "We put decision making as close to the customer as possible," CEO Fred Kriehbiel once explained.

With 60% of the company's volume offshore, AMP takes what it calls a team approach. Researcher Fleck salutes both Molex and AMP for solid management skills and low staff turnover. Senior managers are often 30-year veterans, while most middle managers claim at least 20 years' service. Molex chairman Kriehbiel has been around since he founded the company in 1938.

Entrenched as management is, they're not bashful about changing strategy. "Distribution used to be a dirty word at AMP," says Fleck. Now, the company says its distributor-based sales are the second highest in the United States. Fleck predicts AMP will eventually take over from worldwide top-ranked Amphenol.

Factory sites located over currency boundaries can also save sales. AMP's Yiu says his company produces complete product families in so many locations that he feels insulated from fierce currency swings. He

AMP and Molex fight for top Asian spot

Last year, AMP Inc. got a slap in the face. The number-one ranked worldwide connector maker found its lead over fifth-ranked Molex Inc. reversed in the Asia/Pacific market last year as Molex took the top spot, according to Fleck International, a research firm in Huntington Beach, Calif.

Molex's gains come from its historical predicament. The Lisle, Ill. company moved to Southeast Asia before top-ranked AMP because its appliance-making customers, most of them within a 500-mile radius of Chicago, moved offshore, explains Ken Fleck, president of Fleck International. Higher-end manufacturers in the computer and telecommunication business—which AMP relied on—weren't forced to look for less labor-costly sites in Asia until later.

And when Japan became too expensive for its local customers to continue low-end operations, Molex moved with them into Japan, Taiwan, South Korea, Hong Kong, China, Singapore, Malaysia, Thailand, and India.

One of Molex's competitors argues Molex has too many locations for its own good. Suyin Corp.'s Hong Kong-based sales manager Andrew Ma says Molex stretches out deliveries due to its piecemeal production methods. "They do one thing here, one thing there, moving the product into China, then back again to Hong Kong," Ma says.

How does AMP respond to Molex's new market ranking? "Market data can be misleading," insists AMP's regional marketing manager William I.S. Yiu. Yiu reckons that roughly one-third of a connector's cost is the terminal—that is, the actual connector—while the balance is due to other factors like harnesses. On that basis, he claims that AMP's $89 million in Pacific Rim connector revenue far outpaces Molex's pure-play connector revenue, although Molex earned $102 million in 1989.

One Wall Street analyst suggests the AMP-Molex equation was off by "tens of millions of dollars" and that AMP is clearly in the lead in the Far East outside Japan. Year-to-year comparisons are skewed, he says, because AMP's business year was shortened by one month, ending November instead of December. He argues AMP's Far East volume in 1989 was really closer to $150 million, while Molex was in the $110 million range.

"In round figures, AMP should see $175 million, Molex around $140, in the Far East except Japan in 1990," he says. ☐

CONNECTORS

hints that a new plant may be built in Thailand, where AMP claims 30% market share.

Sales receipts can be difficult to predict when companies have to deal in a crosshatch of currencies. AMP and others, for example, enjoyed high single-digit or better growth in local currencies in 1989 but suffered setbacks when figures were translated back into strengthened U.S. dollars.

"Growth was 11% in local currencies, but only 5% in U.S. dollars," AMP chairman Harold McInnes wrote in his report to shareholders. "Had exchange rates stayed at 1988 levels, sales would have netted $90 million more than they did last year." □

SINGAPORE ELECTRONICS

Who's who on Singapore's top 10 electronics list

MOST OF SINGAPORE'S homegrown electronics companies are still small by international standards and still privately held. But as this *Electronic Business Asia* listing of Singapore's top 10 indigenous companies shows, the highest-ranked players are growing up.

As Singapore's government ushers in a new "era of entrepreneurship" to help foster growth in the $13 billion domestic electronics industry, these leading companies are positioning themselves for a more independent international role. As a result, subservience to multinational corporations is being replaced by in-house product development, and private ownership is giving way to publicly traded stock.

Consider seventh-ranked Essex Group. Dissatisfied with their roles as subcontractors, brothers Benjamin and Patrick Ngiam decided to stop making circuit boards and begin selling their own brand of PCs in 1985 followed by point-of-sale terminals in 1989. The company, whose management now includes three more brothers and a sister-in-law, has grown rapidly since then and now distributes its products in 36 countries. By next year Essex sales are expected to reach $50 million, up from $33 million this year. And by 1991 the company expects to be ready for a public stock offering.

Nearly all the top 10 electronics companies in this island nation—from the huge government-owned Singapore Technologies Industrial Corp. (STIC) to personal computer software retailer Challenger Technologies Pte. Ltd.—are poised to go public within the next five years. STIC, in fact, engineered public offerings for two of its divisions in June.

"It is inevitable as the critical mass grows here in terms of technology that native companies will look more to the future," says David Guest, research director at Hoare Govett Securities in Singapore. "There's a limit to how big you can get as a supplier. What we'll see are these smaller companies beginning to mature and relate to multinational corporations in ways other than just as simple suppliers."

ANN MARIE ANGEBRANDT in Hong Kong

Singapore's top 10 in electronics

	(Total sales, $ millions)	1988	1989
1.	**Singapore Technologies Industrial Corp.** Manufacture of computer, software and semiconductors; leasing; investment	216	350
2.	**Wearnes Technology Pte. Ltd.** Manufacture and sale of PCs and peripherals; contract assembly	132	194
3.	**PCI Inc.** Manufacture and sale of printed circuit boards, LCD; contract manufacturing	43	60
4.	**Eltech Electronics Pte. Ltd.** Contract manufacturing	41	55
5.	**Goh Electronics Singapore (GES)** Manufacture and sale of PCs; OEM computer assembly	33	43
6.	**Singatronics (Group) Ltd.** Manufacture of electronic health care products; PCB assembly; electronic toys and games	35	41
7.	**Essex Group** Manufacture and sale of PC products; computer manufacturing; OEM assembly	17	33
9.	**UIC Electronics Pte. Ltd.** Contract manufacturing	11	28
8.	**Challenger Technologies Pte. Ltd.** Franchise retailer of PC products; computer manufacturing; OEM assembly	27	30
10.	**KT Technology** Manufacture and sale of PCs; OEM assembly	15	24

Source: *Electronic Business* Asia

KOREAN DRAMS

Samsung keeps pace in DRAM development

SAMSUNG ELECTRONICS Co. recently announced the successful development of a prototype 80-nanoseconds 16-megabit dynamic RAM chip, with commercial production scheduled for the second half of 1991.

Samsung, South Korea's largest semiconductor producer, was the first South Korean chip maker to ship 4Mb DRAMs in 1989. Analysts say the company's announcement of a 16Mb DRAM prototype less than a year after its launch of the 4Mb DRAM is intended to reassure customers that the company is keeping pace with leading Japanese and U.S. DRAM manufacturers.

Samsung is hoping that future demand for high-end PCs and workstations, telecommunications equipment, and high-definition television will provide a lucrative market for its DRAM chips well into the 1990s.

IBM, NEC, Toshiba, Matsushita, and Hitachi introduced prototypes or engineering samples of 16Mb DRAMs earlier this year. Hitachi Ltd. is developing a commercial 16Mb DRAM chip in a joint effort with Texas Instruments Inc., and it claims to have produced a lab prototype 64Mb DRAM. But a memory chip of such high density isn't expected to be commercially viable until 1992 at the earliest.

Yong-Kwan Kim of Samsung's strategic planning division for semiconductor business expects prices for the 16Mb DRAM to be just under $300 by the time Samsung gears up for commercial production next year. Samsung Electronics' semiconductor sales in 1989 reached $1.3 billion, up 44% over 1988. Given soft demand for DRAMs in 1990, Kim expects the semiconductor division's sales to grow just 8% this year, to $1.4 billion.

GEOFF CRANE in Seoul

Videoconferencing moves toward the desktop

Market growth is fueled by shrinking costs of equipment and transmission and the emergence of an international standard

BY DWIGHT B. DAVIS

A growing number of corporate executives, engineers, and salespeople are becoming TV personalities of a sort. Shows starring hundreds of businesspeople now play daily on company video screens, thanks to the newly accessible technology of videoconferencing.

In the early 1980s, large aerospace and computer companies, along with other select members of the *Fortune 500*, built expensive videoconferencing rooms. Today, lower equipment and transmission costs, as well as an incipient international standard, are making the technology practical for the business masses.

Worldwide unit shipments of videoconferencing equipment will grow from about 5,400 this year to more than 567,000 in 1996, predicts Market Intelligence Research Corp. in Mountain View, Calif. Vendor revenue during that time will increase from about $113 million to more than $1.4 billion, says MIRC.

The current generation of videoconferencing systems comes in portable "roll-about" configurations and functions as a departmental resource, but the technology will evolve in much the same way that computer technology did, says Ronald D. Baker, director of marketing programs at PictureTel Corp. in Peabody, Mass. While the first computer systems were expensive mainframes and served as corporate-level resources, Baker explains, videoconferencing systems will migrate to users' desktops within two years.

Face-to-face, for a price

Prices for videoconferencing equipment have dropped sharply in recent years. A codec (coder/decoder)—the heart of the system—cost about $165,000 in 1982, says John Tyson, president of Compression Labs Inc. (CLI), in San Jose, Calif. And a full-blown videoconferencing room—containing a codec, cameras, monitors, and audio equipment—cost $500,000 or more. By contrast, today's roll-about systems contain all the videoconferencing essentials in a refrigerator-size package and cost as little as $50,000.

Earlier systems also required high-bandwidth digital lines to carry the video signals that the codec had first digitized and compressed. They operated at T1 rates (1.544 megabits per second) and used expensive satellite links or dedicated terrestrial lines. Today's systems take advantage of the improved video compression algorithms that provide an acceptable picture quality at data-transmission rates that are as low as 56 kilobits per second (kbps).

These dropping transmission requirements mesh nicely with services now available from local and long-distance public telephone networks. Companies can dial switched 56-kbps digital lines (AT&T recently announced a switched 384-kbps service) and can save significantly. Several years ago, a coast-to-coast videoconference over dedicated satellite or terrestrial lines, for example, cost $1,000 or more per hour. Today, the transmission costs for coast-to-coast videoconferencing over tandem 56-kbps lines is just $15 an hour.

Just four or five companies dominate the videoconferencing marketplace, with CLI working hard to retain its preeminence in the area. But recent technological and market changes have blurred business boundaries. CLI pioneered the field in the United States and was able to make its equipment the de facto standard among several of the early aerospace and government users.

It took the arrival of low-cost roll-about systems, notably those from PictureTel, to crack CLI's armor. PictureTel got a jump on CLI at the low end—units operating at transmission rates of 56 to 384 kbps—and in 1989 claimed to ship more codecs than any other vendor.

Videoconferencing, most often touted as a way to cut travel costs, is proving its worth as a marketing and product-development resource

Today, the bulk of videoconferencing action has shifted to the low end, with PictureTel, CLI, GPT, VideoTelecom Corp. in Austin, Tex., and several systems integrators all offering products in the 56- to 384-kbps range. Japanese vendors such as Fujitsu are moving into the U.S. market with low-end products of their own. Most of the major videoconferencing players started out as codec manufacturers and later moved into complete systems.

Now the playing field is shifting under the influence of a videoconferencing standard emerging from the Consultative Committee for International Telephony and Telegraphy (CCITT). The standard is known both as Px64 (essentially an umbrella standard) and H.261 (a substandard that defines a means to communicate and decompress a compressed video signal).

The goal of H.261 is to provide interoperability among different vendors' videoconferencing equipment. Without such a standard, the only way users of different systems can communicate is by going through a "codec farm" like the one operated by public carrier US Sprint. The carrier converts an incoming signal to a form the receiving codec can decipher.

PictureTel and VideoTelecom have already demonstrated the pending Px64 standard in a videoconference linking their equipment. All the major vendors plan to support the standard. Each views Px64 as the lowest common denominator, however, and plans to continue supporting and improving their own proprietary codec algorithms.

Videoconferencing frequently is justified as a way of cutting travel costs. About 70% of employee travel is intracompany, notes CLI's Tyson, which means that a company with an internal videoconferencing network can cut back its travel budget. Even though 30% to 40% of a system's cost is typically repaid in travel savings, however, it's risky to sell videoconferencing solely on the basis of those savings, says T.C. Browne, vice president of the Conference and Satellite Systems Division of Sony Corporation of America. Sony, for several years a systems integrator of CLI's equipment in Asian and European markets, is now marketing its systems in the U.S.

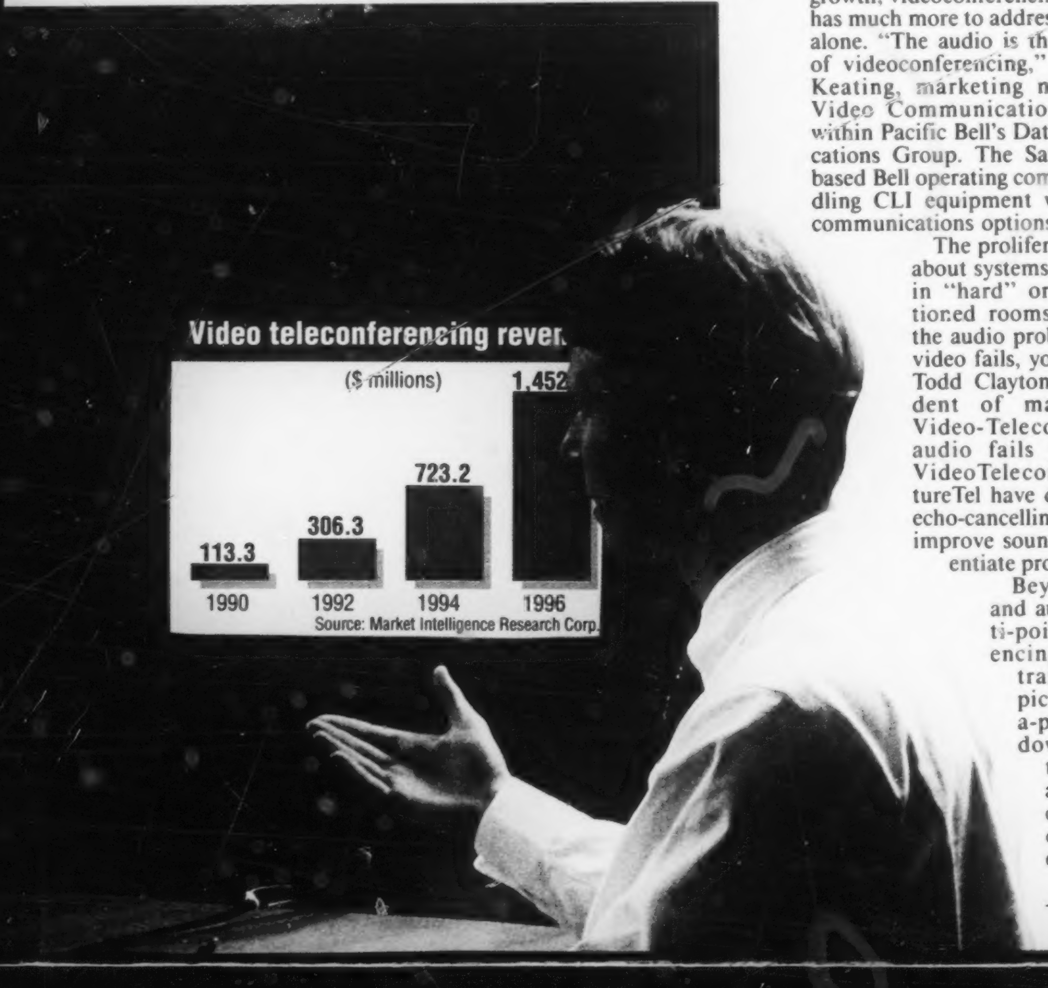
"It's tough to guarantee that a company will save money with videoconferencing because people won't have to get on planes," Browne says. "That's out of the vendor's control." In any case, most users soon find that the system provides benefits well beyond travel savings, such as faster product development.

Beyond video

While the CCITT standard is expected to stimulate the market's growth, videoconferencing ultimately has much more to address than video alone. "The audio is the worst part of videoconferencing," says James Keating, marketing manager for Video Communications Services within Pacific Bell's Data Communications Group. The San Francisco-based Bell operating company is bundling CLI equipment with various communications options.

The proliferation of roll-about systems that operate in "hard" or non-conditioned rooms exacerbates the audio problem. "If the video fails, you talk," says Todd Clayton, vice president of marketing at Video-Telecom. "If the audio fails you walk." VideoTelecom and PictureTel have developed an echo-cancelling circuitry to improve sound and differentiate products.

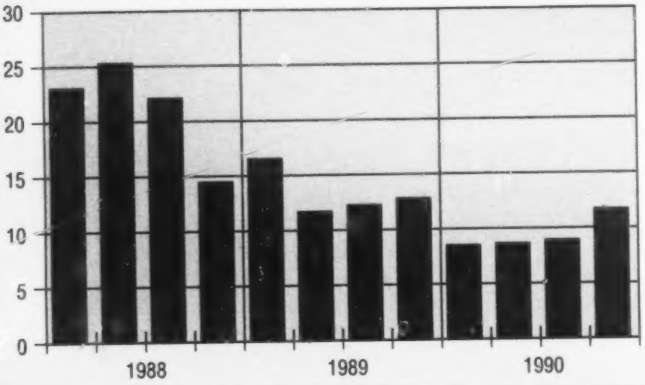
Beyond video and audio lie multi-point conferencing, graphics transmissions, picture-within-a-picture windowing, links to databases and remote control of distant cameras. ☐



Source: Market Intelligence Research Corp.

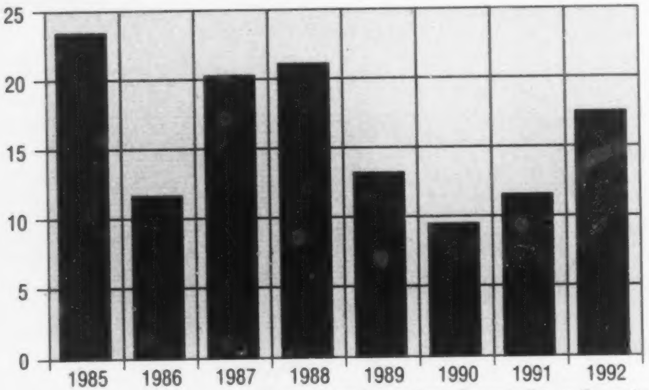
While production is still heading up...

Computer & office equipment production (percentage change from year ago)



...annual growth rates are lowest since 1975

Computer & office equipment production (percentage change from year ago)



Source: Federal Reserve Board; Forecasts: Cahners Economics

Computer output growth rate hits single digits

The computer industry is dealing with the strains of the downturn in the business cycle and the drop in business confidence. In July output from U.S. computer manufacturers grew 0.8% from June, and the preliminary figure for August records another 0.4% gain from July. These levels place output 8% ahead of last year.

Nevertheless, these year-to-year growth rates are some of the lowest the industry has experienced since the economy-wide recession in 1975. The U.S. computer industry had grown accustomed to double-digit output gains for most of the last 15 years.

Cahners Economics doesn't expect this slowdown to last much longer. Prior to the Middle East crisis, new orders for computers and office equipment rose above expectations. In July of this year, orders rose 7.6% from June—the largest monthly gain since March 1989. Further, the industry has kept a watchful eye on inventory. The quarterly average inventory-to-shipments ratio for the computer industry moved no higher than 2.22 in the final quarter of 1989. In the second quarter of 1990, the inventory-to-shipments ratio came in at only 2.11—far below its peak of 2.7 in 1985.

The growth trend is headed decidedly upward. However, the Persian Gulf situation could knock some of the wind out of the next business cycle upswing.

Consequently, my 1990 production forecast calls for just 9.5% growth, the lowest annual increase since the recession of 1976, but 1991 and 1992 will mark a return to stronger growth with annual gains of 11.6% and 17.5%, respectively.

BY MADELINE FRANCHI

Computer market database

Latest quarter: 2nd quarter, 1990	Latest quarter	Previous quarter	Change	Year ago	Change	Next year	Change
Industrial production (SA, 1987=100, qtr. average)	148.80	144.80	+2.76%	136.90	+8.69%	163.60	+9.95%
Shipments (SA, $ millions, qtr. total)	$17,837	$18,022	-1.03%	$17,865	-0.16%	$18,705.9	+4.87%
New orders (SA, $ millions, qtr. total)	$17,598	$17,817	-1.23%	$16,870	+4.32%	$19,493.6	+10.77%
Unfulled orders (SA, $ millions, end of qtr.)	$12,214	$12,453	-1.92%	$12,206	+0.07%	$11,958.4	-2.09%
Inventory-to-shipment ratio (SA, end of qtr.)	2.01	2.01	—	1.95	—	2.10	—
All employees (thousands, end of qtr.)	458.30	463.90	-1.21%	476.90	-3.90%	433.10	-5.50%
Production workers (thousands, end of qtr.)	150.40	154.20	-2.46%	155.00	-2.97%	139.63	-7.16%
Business purchases (SAAR, current $ billions)	$39.76	$40.68	-2.26%	$40.16	-1.00%	$43.05	+8.27%
Business purchases (SAAR, 1982 $ billions)	$123.85	$124.03	-0.15%	$114.71	+7.97%	$141.78	+14.48%

SA = seasonally adjusted; SAAR = seasonally adjusted annualized rate; all other data is not seasonally adjusted

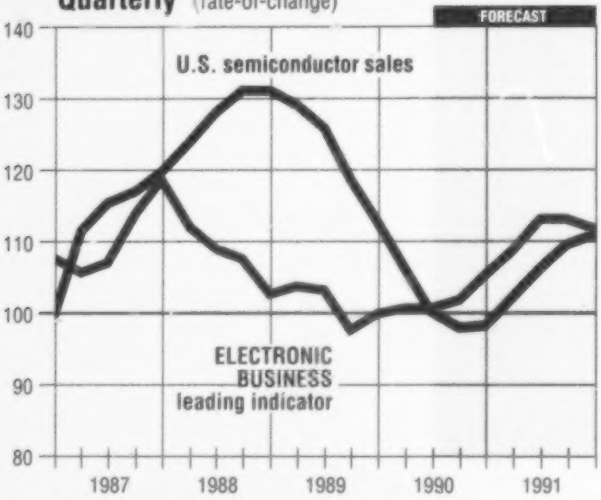
Data sources: Federal Reserve Board, U.S. Bureau of the Census and U.S. Bureau of Labor Statistics
All data for SIC 357, computers and office equipment. Forecasts: Cahners Economics

BUSINESS BAROMETER

FORECASTS FOR ELECTRONICS, COMPUTERS AND SYSTEMS

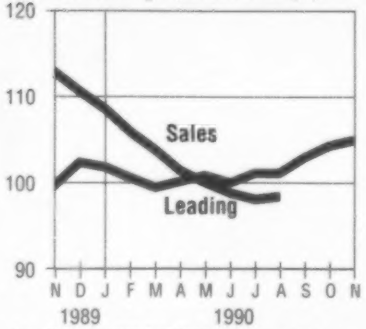
ELECTRONIC BUSINESS leading indicator

Quarterly (rate-of-change)



To obtain your complimentary copy of a 12-page background paper on the ELECTRONIC BUSINESS leading indicator, please contact Linda S. Keehn at Cahners Publishing Company, 275 Washington St., Newton, MA 02158-1630, USA, telephone (617) 630-2119, fax (617) 630-2100.

Monthly (rate-of-change)



The ELECTRONIC BUSINESS leading indicator languished in August at 101, the fifth consecutive month of a figure between 100 and 101. Somewhat encouraging was the fact that the leading indicator did not plunge as a result of the Gulf crisis. But as long as the indicator remains inactive, it becomes less and less likely that semiconductors will make a strong recovery later this year or that electronic equipment will recover next year. According to the indicator, the industry is in a holding pattern and isn't likely to break free soon.

Source: Cahners Economics

Electronics industry indicators this month

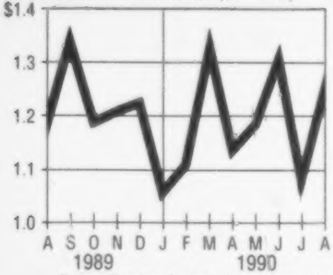
	Latest month	Previous month	Year ago	1989 average
ELECTRONIC BUSINESS leading indicator (rate-of-change, August)	101.0	101.0	97.1	100.9
U.S semiconductor bookings ($ millions, 3-month average, August)	$1,223	$1,287	$1,170	$1,205
Weekly hours of semiconductor production workers (monthly average, July)	39.3	40.5	39.1	40.1
Electronic component leadtime index (1977=100, September)	80.6	85.9	89.2	102.5
S&P's semiconductor stock price index (1970=10, monthly average, August)	64.1	78.2	57.5	54.7
Change in electronic components inventories ($ millions, SA, July)	+$175	-$10	-$178	-$12.8
Contracts and orders for plant and equipment ($ billions, SA, July)	$43.6	$40.0	$46.0	$43.4

SA = seasonally adjusted, all other data are not seasonally adjusted

Sources: Semiconductor Industry Association, U.S. Bureau of Labor Statistics, *Electronics Purchasing* magazine, Standard & Poor's, U.S. Commerce Department, U.S. Bureau of Economic Analysis

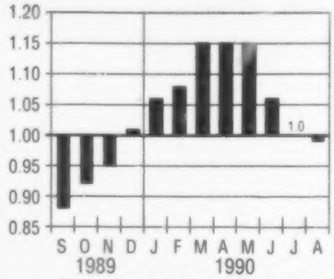
Semiconductor sales

North American market ($ billions)



Source: Semiconductor Industry Association

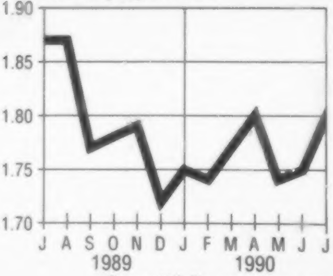
Semiconductor book-to-bill ratio



Source: Semiconductor Industry Association

Component inventory-to-shipments

Seasonally adjusted ratio



Source: U.S. Commerce Department

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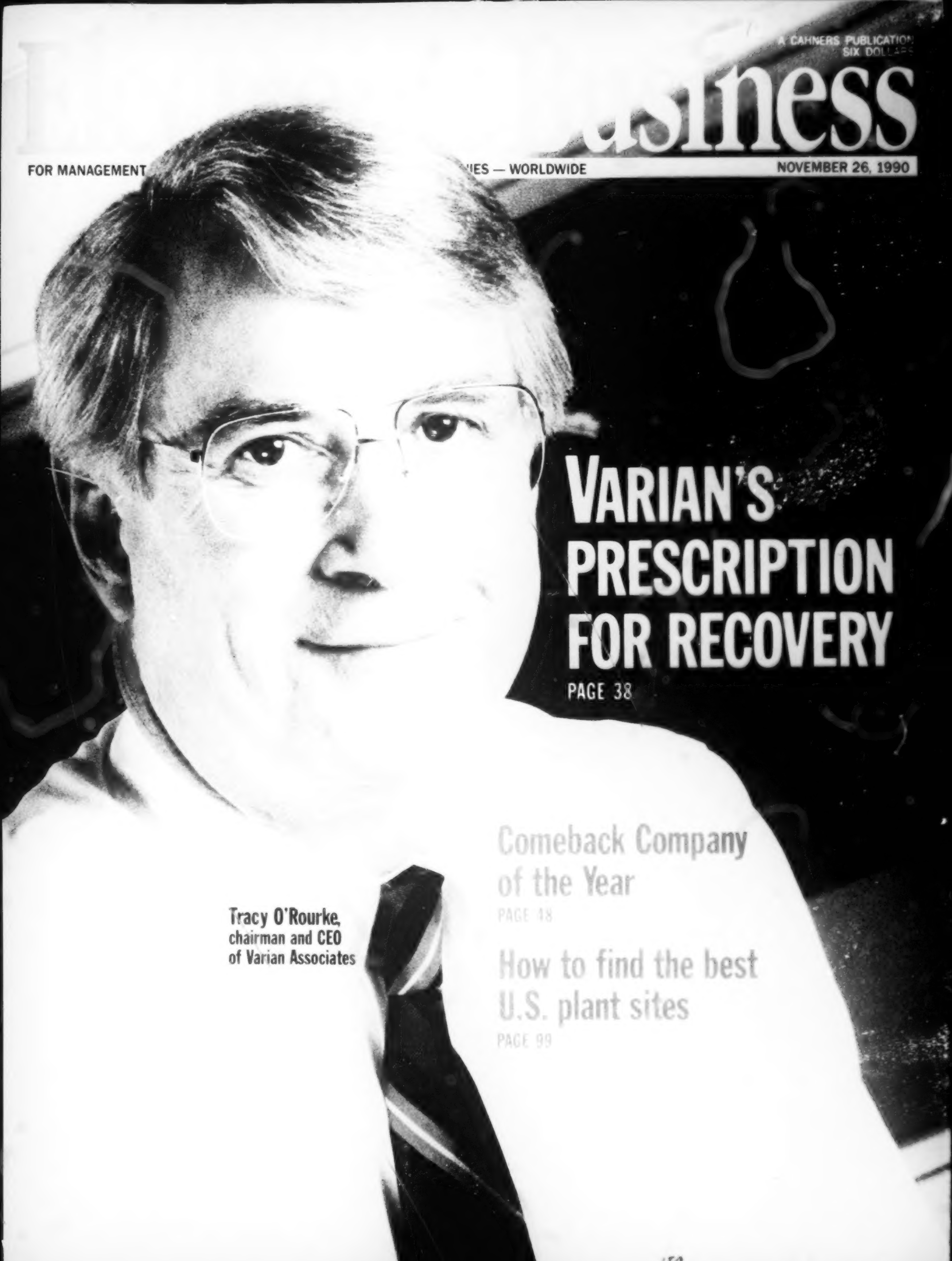

Tracy O'Rourke,
chairman and CEO
of Varian Associates

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FOR MANAGEMENT IN ELECTRONICS, COMPUTER, AND SYSTEMS COMPANIES – WORLDWIDE

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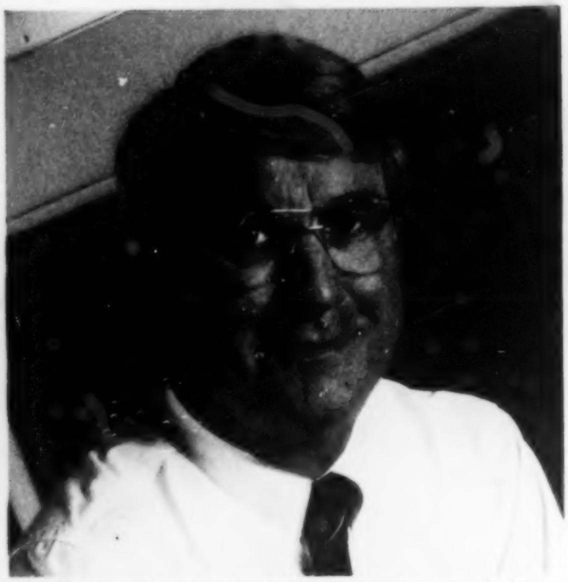

PAGE 38 **Executive VP Allen Lauer: "The problem that Varian got into in the 1980s was that it had no strategic focus"**

COVER STORY/VARIAN

38 Varian's O'Rourke writes his prescription for recovery

How do you cure a company that has lost its competitive edge? That was the problem confronting Tracy O'Rourke last winter when he took the job of chairman and CEO at Varian Associates Inc., the well-known manufacturer of semiconductor equipment and medical instruments. O'Rourke decided on an aggressive course of long-term treatment, and the patient is responding

Cover photograph: Christopher Springmann

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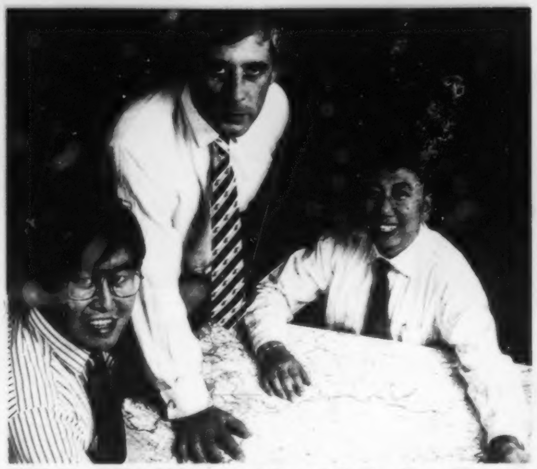
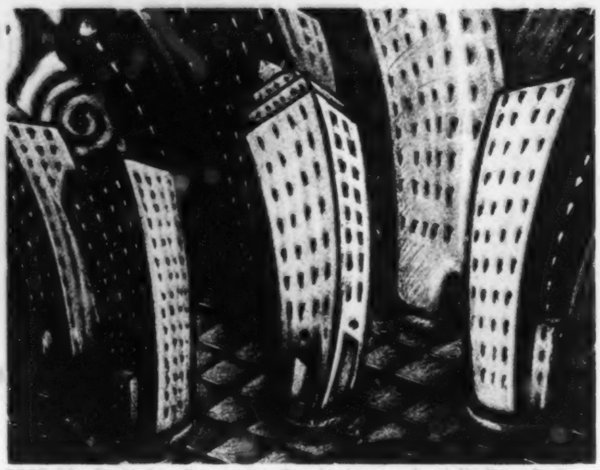


PAGE 71 AMD's PLD team of (from left) Ken Chan, Michael Ballard, Soon Loch is counting on a fast-growth Asian market



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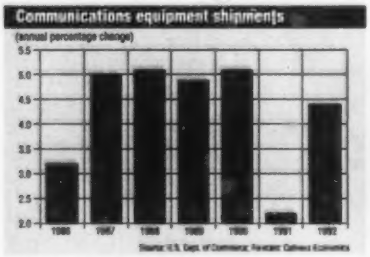

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Coming back means getting tough

Senior editor Rick Whiting (bottom) and associate editor Peter Burrows: tracking comeback companies

Upturn, recovery, comeback. These are odd, encouraging words in a recessionary business climate where the talk is mostly of sluggish sales growth, eroding profits, and slumping capital spending.

To hear of comeback companies these days is to check their balance sheets with a wary eye and then to ask "How did they do it?" In this issue of ELECTRONIC BUSINESS we look at how two companies—Varian Associates, the subject of our cover story, and IRT Corp., ELECTRONIC BUSINESS's choice for Comeback Company of the Year—managed to buck the cyclical trend and indeed "come back."

On the surface, Varian didn't look like a company in need of dramatic change. But beneath the company's technological prestige and consistent sales growth, explains senior editor Rick Whiting, was an operation out of touch with its customers, slow to roll out new products, and mired in a diversification strategy that was pulling the company apart. Inevitably, profit margins—already narrow for a technological company—were becoming dangerously thin.

Twenty-million-dollar IRT, meanwhile, was dancing closer and closer to the edge of the abyss, writes associate editor Peter Burrows. Its technology was unique, its headquarters plush, and its prospectus dazzling; but with multimillion-dollar losses becoming chronic, debt soaring, and banks threatening foreclosure, it was time for radical surgery.

Enter the corporate physicians: in Varian's case, recently hired CEO Tracy O'Rourke; at IRT, an unusual team of self-styled managerial "trench rat" John Battin and Wall Street deal maker Clifford Brokaw.

Along with the conventional slashing and cutting, O'Rourke's treatment calls for refocusing on core businesses, streamlining operations, and emphasizing profitability over growth. CEO Battin reined in IRT's freewheeling marketing divisions, sped up the company's transition to volume manufacturing, and put R&D dollars where they would do the most good. Brokaw slashed spending and brokered new deals with IRT's jittery bankers. So far so good.

Two fascinating stories; two companies on the mend; more evidence that positive change can happen if one dares to use tough remedies.

JOHN PARKER, section editor

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VBPA ABP

hoping that Seeq's flash—which allows organization of memory into sectors which can be erased and reprogrammed independent of other sectors—will emerge as a standard. Production is planned by the first quarter of next year.

The other main flash competitor is Intel Corp., whose flash chips must be entirely erased and reprogrammed. Philips-Signetics plans to use Seeq's flash in consumer and industrial areas, microcontrollers, and telecom chips.

BARBARA JORGENSEN

HDTV

Taiwan tunes in to HDTV research

IN A BID TO increase the competitiveness of its consumer electronics industry and telecommunications technology, Taiwan's government will spend $190 million in the next five years to develop a high-definition television (HDTV) system in cooperation with the U.S. electronics industry.

Taiwan's Ministry of Economic Affairs recently approved the appropriation to fund the development project of HDTV technology, according to the economic news weekly, *Business Taiwan*. Computer and Communication Research Laboratories and Electronics Research and Service Organization, two technology research institutions, have been appointed to lead the project.

Cheng Ray-yu, general director of CCL, says in a preliminary plan, CCL has proposed to set up an advanced TV (ATV) laboratory in the United States, in addition to the development of such key HDTV technologies as liquid crystal display (LCD), charge-coupled device (CCD), high-speed digital signal processing, high-resolution image processing, and bandwidth compression.

According to Cheng, Taiwan has chosen U.S. companies as potential partners rather than Japanese companies, the world's leader of HDTV technology, for a simple reason. "All the leaders of our program have worked with U.S. companies for years, which makes it easier for us to acquire American technological assistance,' " says Cheng.

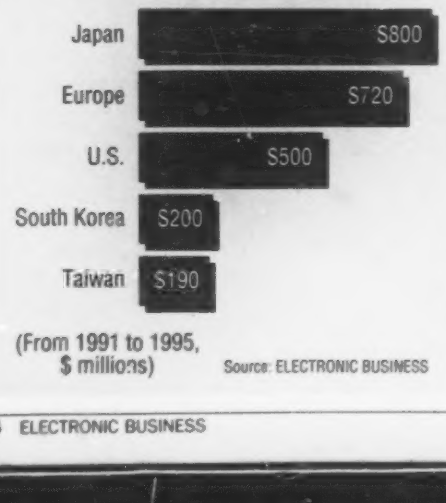
The Japanese HDTV manufacturers, however, have kept their technology top secret. It is reported that if a Japanese-made HDTV breaks down because of a malfunction in a specific part, the Japanese vendor will ask the user to mail in the broken part before sending back a new one. By doing so, it discourages competitors from using extra parts solely for technological experimenting.

Taiwan is the third Asian country, after Japan and South Korea, to announce its government-sponsored HDTV development program. The developer of Japan's Hi-Vision HDTV system, the Japan Broadcasting Corp. (known as NHK), has spent more than 20 years and over $200 million developing Hi-Vision, which became the world's first fully operational HDTV system in June last year. Last June, the Electronic Industries Association of Korea announced its public/private consortium for HDTV development with a five-year budget of $200 million.

Japan keeps its lead in the field through heavy investment. Some industrial analysts estimate that so far, the country has spent between $700 million to $1.4 billion on HDTV development and implementation. In January 1989, Japan's Ministry of International Trade and Industry (MITI) decided to spend $500 million on a 3-year HDTV promotion program. In contrast, the United States and Europe are expected to spend roughly $500 million and $720 million respectively on HDTV development over the next five years.

XIONG XIAOGE

Estimated spending on HDTV for next five years



(From 1991 to 1995, $ millions)

Source: ELECTRONIC BUSINESS

SEMICONDUCTORS

Taiwan, Korea team up as chip partners

U.S. SEMICONDUCTOR companies shopping for Asian partners have a growing number of options from which to choose. Japan's technological expertise remains unrivaled, but both Taiwan and South Korea are coming on strong, according to speakers at The Semiconductor Outlook, an industry forum sponsored by Technologic Partners and Merrill Lynch Capital Markets.

All three countries are good sources of investment capital, says Morris Chang, chairman of the Taiwan Semiconductor Manufacturing Co., "but for cultural affinity, Taiwan is probably the closest to the United States." As for marketing prowess, "Japan is the best [partner] in Japan, but Taiwan is the strongest [partner]in the rest of Asia," he says.

Although Taiwan's fabrication capabilities are on the rise, the country's semiconductor companies lag in applications expertise, says William H. Davidow, general partner at Mohr Davidow Ventures. "They don't know what products to design with their process technology, which makes them ideal partners for fabless semiconductor companies in the United States," he says.

Korea is also eager to establish access to U.S. companies for their design expertise, according to Roger S. Borovoy, a lawyer at Brown & Bain. Borovoy downplayed the potential of Asian companies to appropriate their U.S. partners' intellectual property, noting recent changes that have strengthened patent law.

Given the trend toward fabless operations in the United States and the availability of Asian capital and talent, it is becoming common for start-up companies as well as larger U.S. semiconductor companies to establish Asian ties. That's fine as far as

PCs fuel the hot Asian PLD market

The programmable logic market is one of the chip industry's fastest-growing sectors, and its greatest potential growth is in the Far East

BY ROSS ARENSMAN

By the end of the decade engineers may be able to design PCs on a single densely packed chip, speculates James Huang, director of semiconductor sourcing for Taiwan PC maker Acer Inc. But for the foreseeable future, Acer engineers will have to keep stringing together their most advanced PC designs with the help of programmable logic devices (PLDs)—standard logic chips that can be quickly programmed to handle a variety of tasks.

PLDs provide the "glue" that connects microprocessors, peripherals, and other circuitry in today's PCs. And because customized PLD designs can be created and programmed onto a chip in just a few hours, PLDs have become indispensable tools for PC makers struggling to rush new, more powerful products to market. Huang contends that almost every PC made by Acer today contains 6 to 10 PLDs, usually of the common programmable-array logic (PAL) variety. "Right now it's impossible to do without them," he says.

Demand for PALs and other more sophisticated PLDs has soared in recent years, fueled by widespread use in PCs, enhanced graphics displays, and computer peripherals such as disk drives, modems, and printers. Besides computer products, they are finding their way increasingly into telecommunications equipment like digital switches and PBX systems, as well as industrial controls, test and medical equipment, and even fax machines and consumer electronics.

The industry was reminded of the importance of PLDs earlier this year when demand outstripped worldwide production capacity and created a severe shortage. Spot market prices climbed 20% to 60%, while lead times for purchasing some parts stretched to six months. Several PLD makers increased production in response, however, which appeared to ease the shortage by late summer.

Worldwide PLD sales have grown almost 50%, from $475 million in 1987 to $710 million in 1989, according to the research firm Integrated Circuit Engineering Corp. ICE estimates PLD sales will more than double to $1.7 billion by 1994.

Although the market is still small compared with the memory chips and microprocessors markets, PLDs clearly have turned into one of the industry's hottest growth sectors. Interest in PLDs is particularly strong in Asia, which appears likely to be the world's fastest-growing area for PLD consumption during the next decade.

About $100 million worth of PLDs were sold in Japan last year, according to ICE, while sales in the rest of Asia were over $50 million. The entire region accounted for between 20% and 25% of worldwide PLD sales in 1989, and by 1994 it is expected to generate nearly 35% of the total sales.

"I think Asia will continue to be the fastest-growing market for semiconductors, probably for the rest of the decade—and PLDs will grow as fast as the market, or faster," predicts Michael Ballard, director of Asian sales for U.S.-based Advanced Micro Devices Inc. (AMD), the world's leading PLD manufacturer. He says PLD sales in Asia have doubled during the past three years for the Sunnyvale, Calif.-based company, as has the size of its Hong Kong marketing and support staff, now at 55.

Strong PLD sales are

AMD's PLD team (from left) Ken Chan, Michael Ballard, Soon Loh: counting on Asia being a fast-growth market for PLDs

Hyundai sets sights on PLD market

South Korea's PLD market is still so small that no major market research firms try to measure it. Local industry sources estimate that only about $20 million worth of PLDs are sold annually, with most sales coming from foreign suppliers. But as domestic and international demand for PLDs continues to grow rapidly, at least one of Korea's major chip makers has started to eye the market hungrily.

Hyundai Electronic Industries Co. is the only Korean company currently making PLDs. Hyundai—Korea's number two chip maker—sees PLDs as an opportunity to reduce its heavy reliance on dynamic RAMs.

Han Chang-Seok, senior manager for product planning in the company's semiconductor marketing and sales division, says Hyundai has been looking for ways to expand its non-memory business. Hyundai also wants to meet its own in-house needs for PLDs, he says, and it views PLD manufacturing as a way to use older chip plants after they become unsuitable for memory production.

Hyundai's first PLD chip, the HY18CV8S, is a CMOS-based electrically erasable programmable logic device (EEPLD) developed by International CMOS Technology Inc., a San Jose, Calif., chip design company. Hyundai was an original investor and owns a 30% share in the U.S. company. Hyundai began manufacturing the 300-gate 18CV8 in 1989 and now makes about 200,000 of the chips monthly. At about $1 per chip, that translates into just $2.4 million in annual sales, less than 1% of Hyundai's total chip revenue.

Hyundai is taking a long-term approach to the market and is now developing two higher-end versions of the EEPLD: the 22CV10 and the 22CP210. Like the 18CV8, the new chips will use industry standard architectures and operate at a speed of 25 nanoseconds. But with the equivalent of 600 gates per device, they will offer twice the density of the first generation.

Hyundai's Han Chang-Seok: making the move into the PLD market

Han says Hyundai may also develop a field-programmable gate array, but not soon, because "neither the technology nor the market is mature enough yet."

Han says Hyundai will consume about half of its PLD production internally and sell the rest outside—mostly to Korean systems makers.

Unlike the U.S. and European markets, where demand for PLDs is split fairly evenly among data processing, telecom, and industrial applications, Korea's PLD market is dominated by PC makers. Han estimates that low-density PLDs (under 600 gates) account for about 85% of sales to Korean PC makers.

Ju Jay-Lyang, country manager for Advanced Micro Devices Far East Ltd., agrees there is little current demand for high-speed, high-density chips in Korea. He adds, however, that "as faster PCs are introduced, high-speed devices with lower power consumption will start to look good."

BY GEOFF CRANE in South Korea

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also bringing expansion to the Asian operations of National Semiconductor Co. as well. John Phelps, volume product marketing director at the company's Hong Kong office, says National has more than tripled Asian marketing and support staff outside of Japan in recent years to about 200 people, despite financial problems that forced it to close two U.S. plants and lay off 2,000 workers in late August. Much of the rising demand for PLDs in Asia is tied to the region's booming PC industry, he says.

As PC makers turn to 80386 and 80486 microprocessors to design faster systems, PLD suppliers are rushing to bring out new generations of higher-speed PLDs that can keep up the pace. Until this year the fastest any PLD could process a set of instructions using the most prevalent transistor-transistor logic (TTL) technology was 7.5 nanoseconds. But both AMD and Texas Instruments Inc. recently introduced new TTL PLDs rated at 5 nanoseconds.

"We see a lot of action in these very high speed devices in the next few years—it will be a very important market for any supplier trying to be a major player," says Gilbert Wai, manager of semiconductors for Texas Instrument's Hong Kong subsidiary.

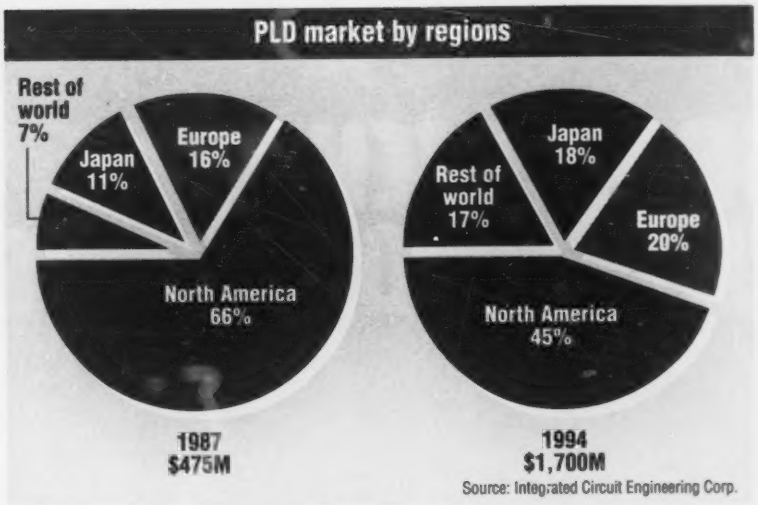
"The market didn't exist two years ago," he says. "Now people are beating down the doors trying to get their hands on these parts."

Without a doubt, the hottest segment of the PLD market in the 1990s will be CMOS (complementary metal-oxide semiconductor) technology. Bipolar PLD growth peaked in 1988 and CMOS technology has been coming on strong ever since. ICE estimates that CMOS PLDs will account for 37% of the worldwide market this year and 57% of the PLD market by the end of 1994.

But Asian demand for CMOS PLDs has so far been slow to take off. Officials at AMD and the other bipolar companies say the shift to CMOS PLDs has been sluggish partly because of the Asian electronics industry's emphasis on manufacturing PCs and related products, which often require the extra speed of bipolar devices.

Chip designers are still a long way

PLD market by regions



Source: Integrated Circuit Engineering Corp.

from producing CMOS PLDs fast enough to keep up with the latest bipolar devices. The fastest CMOS PLDs currently are in the 10-nanosecond range, half the speed of the latest TTL bipolar devices.

But what CMOS PLDs lack in speed, they more than make up for in terms of power consumption and density. CMOS PLDs are ideally suited for use in laptop and notebook PCs, as well as cellular phones and other battery-powered products, because they typically require less than half as much power as their bipolar equivalents. CMOS technology also allows much more circuitry to be squeezed into a smaller package—another advantage in building lightweight and portable products.

Most CMOS PLDs have a further advantage of being reprogrammable, which makes it easier for engineers to correct mistakes and update designs. Some varieties, such as those that use electrically erasable programmable memory (EEPROM) technology, can be reprogrammed electrically without removing them from the system where they are installed.

"Asia is still higher than the worldwide average in terms of bipolar consumption, but the CMOS segment is also growing very strongly," says Soon Loh, AMD's Asian business development manager.

No single company controls the fast-growing CMOS market to the extent AMD dominated the bipolar market. The leading CMOS supplier during 1989 was Altera Corp. of Santa Clara, Calif., whose sales of $50 million accounted for 19% of the market. A group of other relatively small U.S.-based companies—Cypress Semiconductor Corp., Xilinx Corp., and Lattice Semiconductor Corp.—held the next three places, according to ICE.

Erik Cleage, Altera's director of sales for Japan and Asia, says the seven-year-old company sells about 17% of its PLDs in Japan, and another 3% to 4% in the rest of Asia. Altera makes a wide range of CMOS PLDs, from inexpensive varieties aimed at replacing standard PAL devices, up to complex gate-array-like PLDs with up to 5,000 gates or transistors. A 20,000-gate product is scheduled for introduction sometime next year.

About $100 million worth of PLDs were sold in Japan last year while sales in the rest of Asia were over $50 million

While Asian semiconductor makers held 11 of the top 20 spots in Dataquest Inc.'s 1989 ranking of the largest chip makers, there are virtually no Japanese or Asian companies to be found in the PLD market. However, with the exception of N.V. Philips of the Netherlands and its U.S. subsidiary, Signetics, the PLD industry is dominated by the United States.

One of the few Asian companies trying to break into PLDs is Korea's Hyundai Electronic Industries Co., but so far its sales account for only a fraction of 1% of the PLD world market. The reason, say industry observers, is patent protection.

Since 1978 when Monolithic Memories Inc. (MMI) developed the first PAL, U.S. companies have applied for patent protection on their new PLD products and defended patents vigorously. The strength of that protection was demonstrated in April when AMD, which acquired MMI's patent portfolio in a 1987 merger, forced Samsung Semiconductor Inc. to drop PLDs. Samsung had been building PAL-type devices as well as CMOS PLDs based on AMD's 22V10 architecture, and many analysts had already picked Samsung as the next major player at the low end of the market.

"Samsung suffered a major setback in the PLD patent case with AMD," according to Bill McClean, vice president of market research at ICE. "They may return with a redesigned PLD product," he continues, "but it will be a while before Korean producers are strong PLD competitors."

Patents should pose less of a problem for Hyundai, with its technology licensed from San Jose, Calif.-based International CMOS Technology Inc. Hyundai also owns 30% of ICT. "We can apply that technology to modified or enhanced versions," according to Han. Still, he admits Hyundai does not have the "capability to develop a whole different type of PLD."

Several Japanese chip makers, including Fujitsu Ltd., Toshiba Corp., and Ricoh, have dabbled in the market, but none has yet made a significant product introduction. One reason for Japanese makers' reluctance is the small size of the PLD market. But that explanation now carries less weight as PLD sales rapidly approach the $1 billion mark.

"If there were no patents to contend with, I believe any of the Asian manufacturers would love to be in the market," according to AMD's Loh. □

Workstations battle PCs for rights to the technical desktop

CAD/CAM/CAE is shaping up as a pivotal battleground for workstation and personal computer vendors vying to establish the standard technical platform of the future

BY PETER BURROWS

What happened to the days when a workstation was a workstation and a personal computer was a personal computer? When you bought the former, you got a high-performance item based on the powerful Unix operating system for big bucks directly from the manufacturer through a highly trained salesperson. When you bought a PC, you got an easy-to-use jack-of-all-trades that could be bought almost anywhere for a few thousand dollars.

If not gone entirely, those days are rapidly disappearing. Some workstations now cost as little as $5,000 and can run Unix-based versions of such PC software standards as Lotus 1-2-3 and WordPerfect. With vendors eagerly looking for new sales channels to increase volume, workstations are beginning to show up more often at the dealerships, value-added resellers (VARs), and other third-party outlets that make up the traditional channel for PC distribution.

At the same time, high-end PCs now rival workstations in power, performance, and even price. Fully loaded configurations armed with Intel Corp.'s state-of-the-art 80486 microprocessor, extra memory, and enhanced graphics and networking can sell for almost $20,000, and many are being used for high-end applications, such as three-dimensional modeling, that were never before considered to be within the realm of the PC platform.

Nowhere is the overlap between the two platforms more clear than in the market for computer-aided-design (CAD), computer-aided-manufacturing (CAM), and computer-aided-engineering (CAE) software tools. Rapid improvements in the price/performance of workstations recently have caused CAD/CAM/CAE users, software developers, and resellers of every description to revise their strategies. The fallout, which analysts say will be evident within the next few years, will say a great deal about what the technical computing platform of the future will look like.

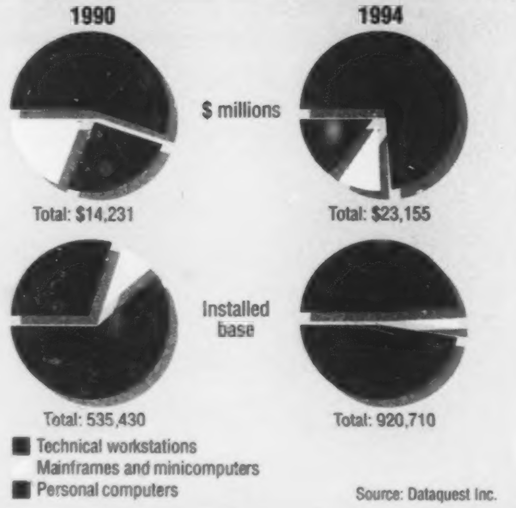
For now CAD/CAM/CAE remains a PC-based industry. More than twice as many PCs as workstations were sold into these markets in 1989 (279,200 and 116,500, respectively), according to market researcher Dataquest Inc. in San Jose. However Charles Foundyller, president of Daratech Inc., based in Cambridge, Mass., estimates much greater PC dominance; he believes that workstations represented only about 5% of total CAD/CAM/CAE hardware sales in 1989.

One scenario, promoted most aggressively by Sun Microsystems Inc. of Mountain View, Calif., would see the workstation completely replace IBM PCs and compatibles as the standard platform for CAD/CAM/CAE, as well as for more general business applications. By liberally licensing its scalable portable architecture (SPARC) and expanding its third-party sales channels, Sun has made impressive strides in breaking into the high-end PC marketplace. But other major workstation vendors, such as IBM and Hewlett-Packard Co., say the convergence of PC and workstation technology is a moot point. "We see them as complementary technologies," says Ron Gentile, a marketing manager of enabling technologies with HP. "Heterogeneous computing is the way it is out there, and neither platform is going to go away."

The numbers bear him out. Sales of workstations and PCs into CAD/CAM/CAE have risen at approximately the same rate since 1985, according to Dataquest numbers—16.8% annually for PCs and 17.5% annually for workstations—as each has grown on the strength of rapidly developing, clearly defined high- and low-end segments of the market.

But now, with a range of technical hurdles crossed

Workstations outpace PCs in CAD/CAM/CAE



Source: Dataquest Inc.

and with cutthroat competition compelling workstation vendors to seek out high-volume sales in the low end of the market, observers expect the scales to tip in the workstations' favor. Kathryn Hale, a senior industry analyst for Dataquest, expects workstations to overtake PCs in yearly unit sales by 1994, based on annual sales growth of 12.9% between 1990 and 1994, compared with 5% annual growth for the PC during that period.

Minicomputers and mainframes, running software costing upwards of $100,000, dominated CAD/CAM/CAE until Autodesk Inc., in Sausalito, Calif., revolutionized the market in 1982 by selling low-cost PC-based products for about $1,000. Dataquest expects minicomputer and mainframe sales into the CAD/CAM/CAE market to fall 9.2% per year through 1994, from 48,720 units to 33,270 units.

Unix comes on strong

Technically, the choice between PCs and workstations has become confused. While PCs typically still offer lower absolute systems costs, given the lower cost of PC software, many workstations offer better price/performance for the hardware itself. Workstation costs have been falling 15% per year, several industry insiders estimate, and they expect this curve to steepen in coming years. In many ways, the technologies have already converged; while workstations are designed with networking capabilities, superior graphics, and virtual memory, PCs can be outfitted with those features.

"We have to write next year's hardware budget so that we're ready for whatever the future holds, because who knows what's going to happen by then?" says Jerry Flynn, a design engineer with the McDonnell Douglas Space Systems Co. at its division at the John F. Kennedy Space Center in Florida.

Flynn, who uses a system featuring DOS- and Macintosh-based PCs as well as workstations, with software that is fully compatible with all three, expects workstations to advance as far as the software available for the platform will take them. Where DOS was developed for stand-alone hardware on which individual tasks are done one at a time, Unix, the standard for major commercial workstation platforms, offers multitasking (the ability to run more than one application at a time) and superior data-management capabilities in a multiuser environment. "And now," Flynn says, "all of the reasons for not going to Unix are kind of dissolving away."

Progress has been made in a number of areas:

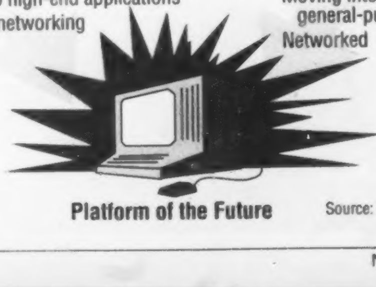
- Ease of use. Software enhancements, such as graphical user interfaces and compilers that easily translate DOS-based programs into Unix formats, have made the much-feared Unix much less difficult to use. While Unix-based operations still typically require the services of a full-time systems manager, users report that in some configurations Unix is all but transparent to the application user.

There are some signs of a resurgence of DOS-based PCs in the world of CAD/CAM/CAE

- Price. Workstation prices have fallen drastically as the cost of memory, disk drives, and chipsets has plummeted. LSI Logic Corp. in Milpitas, Calif., for example, is selling its SparKit chipset at prices designed to "enable the low-end workstation vendors to sell their products for $5,000 or $6,000," marketing director Prem Nath reports. The result is a changing of the guard in pricing for a growing segment of the market. One vendor of both PC and workstation-based CAD/CAM/CAE solutions lists a low-end SPARCstation IPC from Sun at $9,995. A high-end DOS machine, the Deskpro 486/25 from Houston-based Compaq Computer Corp., configured for similar performance, lists for $13,999.
- Application availability. Long regarded as a platform only for highly specific, highly complex applications, many CAD/CAM/CAE vendors—including four of the five market leaders—now offer their core products on Unix-based workstations as well as DOS-based PCs. Some are responding to incentives from hardware vendors anxious to reach a critical mass of software for their platforms. Others are fearful of being left behind should Unix take hold at the lower end of the market. "We want to fit into every engineer's desktop environment, and in our market there simply happens to be two standards," says Jon K. Hirschtick, chairman of mechanical CAD vendor Premise Inc. in Cambridge, Mass. His company's product runs four to five times faster under Unix than under DOS, he claims.
- Accessibility. For the above reasons and more, a variety of distributors, dealers, systems integrators, and VARs are now selling workstations and Unix-based CAD/CAM/CAE tools. While the high cost of hiring and training Unix-literate personnel

Convergence of workstations and PCs

	PCs	Workstations
1980	Low cost Low-end, general purpose Stand-alone	High cost High-end, specific applications Networked
1990	Rapidly rising performance Slowly falling prices Moving into high-end applications Increasing networking	Rising performance Rapidly falling prices Moving into low-end, general-purpose applications Networked
2000		

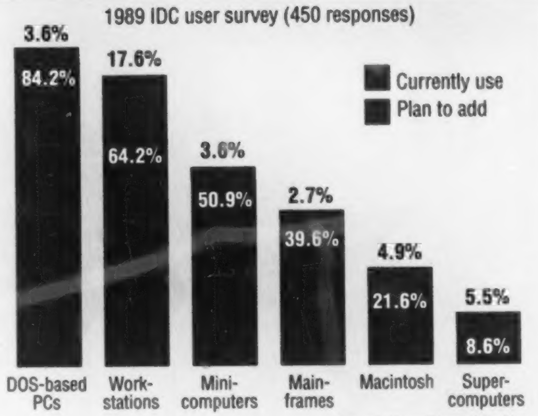


Platform of the Future

Source: ELECTRONIC BUSINESS

represents a high barrier to entry, these resellers are attracted by the promise of higher margins than on PC-based systems, as well as by limited competition as the channels develop. The results so far indicate that these third parties represent an effective mechanism for expanding workstation sales. Sun reports that its 150 dealers have doubled sales over the past year. VAR sales on the whole, according to Daratech, are outpacing the industry, with annual sales growth of 33% compared with 13% for CAD/CAM/CAE in general.

The PC has volume; the workstation has growth



Source: International Data Corp.

Whither the PC?

Some observers contend that the PC is ripe for a fall. But recent developments such as the introduction of Microsoft Corp.'s Windows 3.0 and the existence of hundreds of DOS-extender programs and PC-accelerator cards have given new life to this nine-year-old technology, some say. But doubters counter that those developments are simply more evidence that the PC needs artificial respiration to keep up with the times. Jeff Arnst, a market-segment manager with Sun, estimates that 35% of all PC-based CAD/CAM/CAE tools are currently running on extended versions of DOS.

But the PC isn't going away—far from it. Reseller channels for workstations will take years to develop, since resellers must be trained to handle the complexities of Unix, and customers must get used to having an option on the showroom floor. And while many of the thousands of DOS-based CAD/CAM/CAE programs have been converted to Unix recently, few offer true compatibility across platforms—far too few to satisfy the fickle buying habits of PC devotees used to choosing from hundreds of other mature options.

"The PC, if for no other reason than that there are tens of thousands of useful and necessary applications for every aspect of business at extremely attractive prices, will continue to be a high-demand platform," according to Dave Millman, marketing director of the PiCAD division of CADAM Inc. in Burbank, Calif., an IBM subsidiary, which entered the Unix market this year.

But an estimated installed base of between 35 million and 50 million devoted DOS users may be the most imposing barrier for competing platforms. "DOS may be an inelegant solution to some problems as of now," according to Daratech's Foundyller, "but it has the unit volume to make it worthwhile for someone to find a way to get around its limitations. With all those clever people working on the problem, it is highly unlikely that they will be unsuccessful."

Users, software developers, and resellers are caught in limbo as the two platforms converge

Indeed, there are some signs of a resurgence of DOS-based PCs in the world of CAD/CAM/CAE. Evidence includes the failure of OS/2, the much-hyped multiuser operating system for the PC introduced by Microsoft in 1987 to provide a migration path for DOS users, which has yet to overcome resistance from application developers. While Microsoft will introduce a new release of the operating system sometime next year to run on 80386 machine, users and software vendors complain that the standard has not been made sufficiently attractive and consider it a stopgap solution.

Clearing the confusion

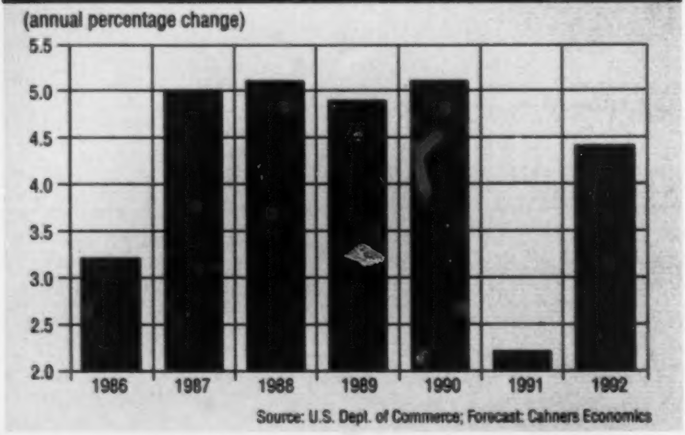
Users, software developers, and resellers are caught in limbo as the two platforms converge into each other's turf, and the onus increasingly rests with the hardware vendors to deal more directly with the issue. Besides Sun, few hardware vendors have clearly outlined their view of how the collision will shake out—possibly because major competitors such as IBM and Compaq, who offer products in both of the categories, have yet to deal with the question themselves.

"The question is, can the PC vendors continue to add more integration to their platform faster than the workstation vendors can achieve a general-purpose platform?" according to Steve Malisewski, director of applications marketing for Compaq. "The workstation vendors may have raced ahead in terms of integrating everything the user needs into one computer, but there aren't any barriers to the PC industry following their lead. We are all building our products from the same shopping cart."

Compaq, for one, has given indications that the end result may well be a shake-up of the current industry profile. The company, the quintessential premium PC vendor, has discussed opportunities involving the SPARC architecture with Sun, although it has not disclosed details. A growing number of other PC makers are also making the move into the workstation business: In mid-October, LSI Logic announced that vendors including CompuAdd Corp. in Austin, Tex., DTK Computer in Taiwan, and Hyundai Electronics in Korea, are building SPARC-based products based on LSI's SparKit chipset.

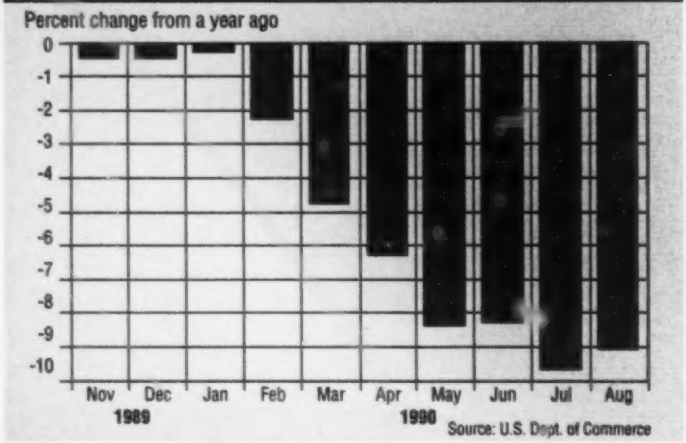
"When you look over the horizon, you see that it will take a 32-bit operating system to do what we will need to do someday," according to Compaq's Malisewski. "When it's necessary, we will move into that domain." ☐

Communications equipment shipments



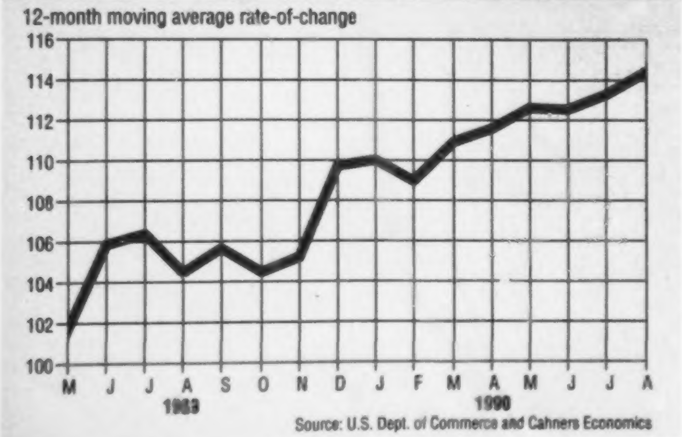
Source: U.S. Dept. of Commerce; Forecast: Cahners Economics

Communications equipment inventory



Source: U.S. Dept. of Commerce

Nondefense communications equipment orders



Source: U.S. Dept. of Commerce and Cahners Economics

New orders rise for communication products

By the end of the summer, growth in shipments of communication equipment was running about two percentage points higher than Cahners Economics' expectations. If this trend continues, total shipments could expand by 7% to 8% this year, once all data are in, rather than our current forecast of 5.1%. Not surprisingly, manufacturers have kept a lid on production growth during the current economic slowdown and have instead whittled away at inventory to keep shipments growing.

The surprising news is the increased flow of orders received by U.S. factories. With 12 months of data ending in August, net new orders for communication equipment swelled to $83.2 billion—11.8% above the prior 12-month period. So far, the upward growth trend has not been knocked off-track by the happenings in the Middle East. This strength in new orders has stemmed the decline in backlogs that began in the middle of 1988.

In particular, non-defense communication equipment suppliers have enjoyed a steady stream of orders. Growth rates have risen almost unabated since the middle of 1989, resulting from the burgeoning need for voice, data, and video communication. Driving the demand are productivity enhancements and cost savings from installing digital networks, as well as newly opened foreign markets. With the 12 months ending in August, net new orders for telecommunication and datacommunication equipment swelled 14% from the prior year.

One sector experiencing rapid growth is fiber optics. The U.S. Department of Commerce estimated that the U.S. fiber-optics market grew 7%, to about $1.1 billion in 1989, including parts, systems, and cable. The telecommunications industry consumed over three-quarters of fiber-optic production, but with most long-distance and regional systems overhauled and the cost of deploying fiber declining, fiber optics is moving into the local loop—the delivery of service from a telephone company's central office to a home or business. Business Research Group in Boston predicts the total number of regional Bell operating companies' fiber access lines to the customer will grow nearly 15% annually between 1990 and 1995. Fiber optics also is being used increasingly in local area networks, cable television networks, and military applications.

MADELINE FRANCHI

Blue chip vs. Cahners macroeconomic forecasts

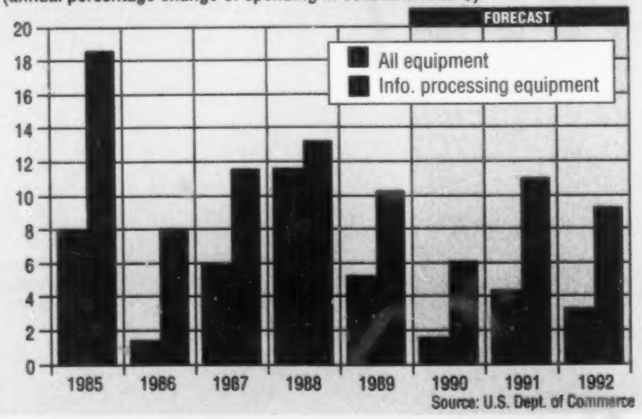
(annual percentage change)

	Blue Chip Consensus		Cahners Economics	
	1990	1991	1990	1991
Real GNP	1.0	0.8	1.4	2.4
Consumer price index	5.4	5.1	5.4	3.9
Industrial output	1.1	0.8	1.3	2.7
Disposable income	1.2	0.8	1.5	2.1
Business investment	0.5	-0.5	1.3	3.8
Pretax profits	-4.2	0.7	-3.4	5.0

Source: Blue Chip Economic Indicators and Cahners Economics

Business investment growth will pick up...

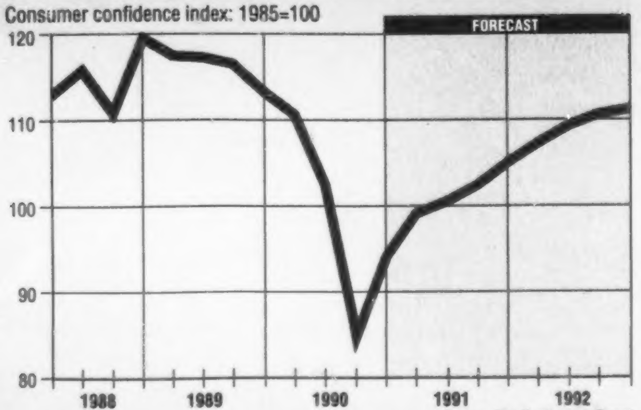
(annual percentage change of spending in constant 1982 $)



Source: U.S. Dept. of Commerce

...And so will consumer confidence

Consumer confidence index: 1985=100



Source: The Conference Board

U.S. economy can avert an oil-shock recession

What a difference a crisis in the Middle East makes. The economic consensus forecasts have taken a turn for the worse. According to the Blue Chip Economic Consensus in Sedona, Ariz., 50 forecasters in the U.S. last month estimate on average that real GNP will rise just 1.0% in 1990 and a meager 0.8% in 1991. Prior to Iraq's invasion of Kuwait, the group had been forecasting 1.9% and 2.2% growth, respectively. (In the March 5, 1990 issue of ELECTRONIC BUSINESS, the consensus' forecast had been 1.6% and 2.5% GNP growth.)

But the true impact on the economy of the current Gulf crisis remains largely unknown. Without further interruptions in that region's crude-oil supplies, the shortfall is minor and is rapidly being made up by other countries. The commodities market has hurled oil prices into the stratosphere, but the price of oil would have to remain above $60 a barrel to equal the shock produced in 1974.

The result of continued uncertainty and bruised consumer confidence will no doubt mean less economic growth next year. However, we at Cahners Economics maintain real GNP will grow 2.4% in 1991. That prediction has been lowered from the July forecast of 2.8% and a forecast of 3% published last March.

What makes Cahners Economics a relative optimist about next year? We specialize in forecasting micro markets. The forecasts for industrial products, materials, electronic components, building materials, and other discrete markets underlie our GNP forecast. We also focus on the turning points in the business cycles for these markets. According to our analysis, the industrial base of the economy is poised for a turnaround now, although the expansion will be somewhat muted.

The recession, if it does happen, will be led by a severe cutback in consumer spending and could easily be prompted by a war in the Middle East. Yet without a war, it is still a safe bet that the U.S. economy will slink by in 1991 with 2% growth or above.

ELIZABETH B. BAATZ

The hottest European markets ■ How U.S. companies can win

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Electronic Business®

FOR MANAGEMENT IN ELECTRONICS, COMPUTER, AND SYSTEMS COMPANIES —WORLDWIDE
DECEMBER 10, 1990

THE NEW EUROPE

Electronic Business

FOR MANAGEMENT IN ELECTRONICS, COMPUTER, AND SYSTEMS COMPANIES—WORLDWIDE

VOL. 16, NO. 23 DECEMBER 10, 1990

THE NEW EUROPE

COVER STORY/THE NEW EUROPE

38 The door opens to the New Europe

Big multinational electronics companies have been selling in Europe for years; now smaller companies are assessing their chances. For most of them, the question is not whether to explore the changing European marketplace, but how to find the fastest and safest route. This special issue is ELECTRONIC BUSINESS's guidebook to that marketplace

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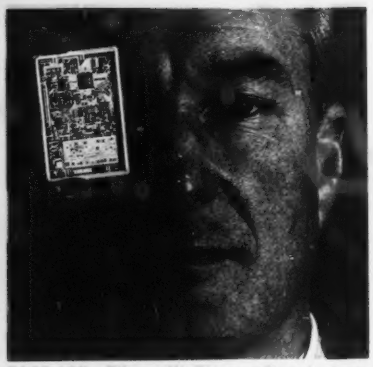

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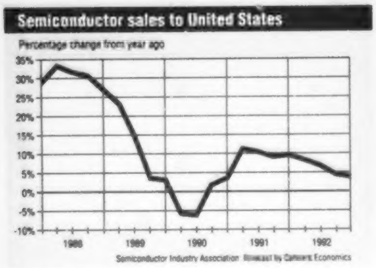

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The "New" Old World

The French author Restif de la Bretonne deserves a posthumous award for accurate forecasting. He predicted in 1792 that 200 years later, Europe would converge into a single-nation state—but everyone would still be arguing about it.

As 1992 approaches, the nations of Europe are indeed converging—economically and politically—and argument and confusion abound. A U.S.-based electronics company eager to do business in Europe today has to sort out a complex array of factors: capital sources, currency fluctuations, merger regulation, plant sites, government incentives, and distribution services. And that U.S. company has to think fast, because the European deadline for conversion to a single market is looming and the flat domestic economy is gnawing away at profit margins. Already, major U.S. electronics and computer companies are realizing 40% to 50% of their sales revenue abroad—with the fastest growth projected in Europe. Is it too late for your company to cash in? What are the risks, and what are the rewards?

On the European beat: Senior editors Barbara Berkman (right) and Teri Sprackland, and managing editor Garrett DeYoung

Realizing that for many U.S. companies the Old World has become the New World, we dedicated this special issue of ELECTRONIC BUSINESS to Europe. We can't settle the arguments, but we can help clear up the confusion.

Frequent-flyer records were broken to produce this issue. Managing editor Garrett DeYoung, San Jose-based senior editor Teri Sprackland, and London bureau chief Barbara Berkman made a grand tour of the European electronics industry. In France, they found a village in Provence being transformed from vacation paradise to high-tech mecca. In Italy, they found an ambitious $700 million government incentives program that helped Texas Instruments produce DRAMs deep in the heart of Mezzogiorno. They found drawbacks: High costs and local brand loyalty partly offset the strength of Germany's electronics market and massive infrastructure problems mar the promise of doing business in countries east of the Elbe.

No tour of the New Europe would be complete without a stop in its capital, Brussels—home to the European Commission. As contributing editor Linda Bernier reports, winning hearts and minds in Brussels requires skills far different from those employed by most industry lobbyists in Washington. "In the United States, you fight and you win," says one EC official. "Here, you discuss and you compromise"—just one of many lessons U.S. executives need to learn as they move to explore and colonize the new Old World.

JOHN PARKER, section editor

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WORKSTATIONS

Sun leads assault on high-end of PC marketplace

SUN MICROSYSTEMS Inc., the market leader in workstation sales, is leading the charge to take away the high-end of the personal computer market. "We want to be the platform of choice for anyone who is doing traditional CAD and high-end engineering analysis," says marketing manager Jeffrey Arnst. "But it is not just CAD—it's project management, it's accounting, it's business, it's word processing. We would like to own the marketplace for the desktop for the professional—whether lawyer, doctor, or engineer."

This audacious assault has familiar overtones. "Sun is trying to position itself in the workstation market the way IBM did in the PC market," says Harmon Cadis, president of ICT Technologies, a Saginaw, Calif.-based reseller of PC- and workstation-based CAD solutions. "They realize they aren't going to get it all, but they would be fine if they could wrap up 20% to 30%."

Cornerstones of the strategy include liberal licensing of Sun's proprietary SPARC reduced instruction set computer (RISC) technology to help grow the market and make the platform a general standard. The company has licensed 7 semiconductor companies to develop and sell SPARC chips commercially and has granted to at least 6 others the right to use SPARC chips in their own systems. All told, the company estimates that at least 36 companies have developed SPARC-based computers, from laptops to supercomputers. One licensee, LSI Logic Corp., announced that 10 PC-clone makers are developing such systems using their SparKit chipset.

And like Big Blue, Sun is aggressively signing up third-party vendors. While the workstation vendors have traditionally limited themselves to direct sales due to the complexity of the product and the ability to achieve higher margins, Sun has rewritten the rules in this respect. "We haven't been able to reach all the customers we want to reach through direct sales," says Bob McInroy, manager of mechanical market development. "We have low-cost products now, so we have to find new ways to distribute them. We have maxed out our direct-sales channels."

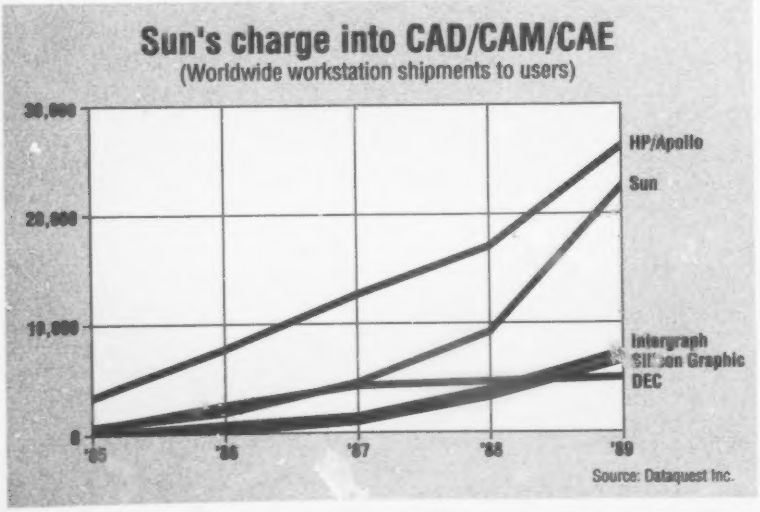
As of early autumn, the company had signed up a network of VARs, dealers, retail franchise operations, distributors, original equipment manufacturers, and systems integrators. The hottest-selling box from the start has been the SparcStation IPC, which retails at $5,000. Dealers sales are twice what they were last year, moving along at a clip of 2,500 per month, says Arnst, "and those are the kinds of volumes that software developers are happy to get 1% of."

Indeed, Sun's success in attracting applications developers to port to the SPARC platform may be the company's most impressive initiative to date. From a base of only 200 last year, over 2,000 applications now run on Sun, says Arnst. That includes applications from over half of the third-party developers for AutoDesk Inc., the Sausalito, Calif., company that dominates the PC-based CAD/CAM/CAE business with market share exceeding 70% by most counts.

Skeptics say that vanquishing the PC is too big a job for any one company. But in the brash style of its CEO, Scott McNealy, Sun does not cower from taking on the IBM and IBM-compatible PC market, which has an estimated installed base of up to 50 million units. Instead, the company seems dedicated to a strategy of "intentional commoditization": Cut out the competition's profit margins by turning your proprietary technology into the industry standard, and set up a suite of applications and reseller channels to ensure high volume of sales.

"Customer loyalty has to do with price more than platform," says McInroy. "We have already got them beat there, and we are focused on the key applications. We may not have thousands and thousands of programs, but most people only use two or three anyway. Just look at [Apple Computer Inc.'s] Macintosh."

PETER BURROWS


Sun's charge into CAD/CAM/CAE
(Worldwide workstation shipments to users)

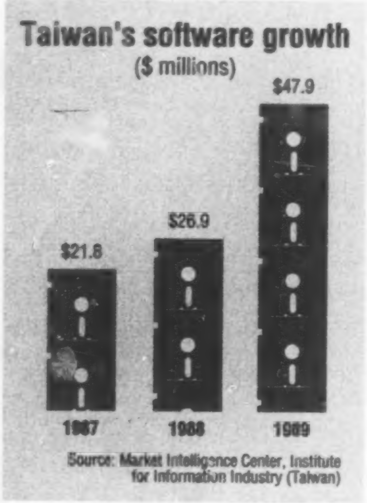
Source: Dataquest Inc.

TAIWAN

Taiwan bets on software industry

U.S. ELECTRONICS companies may benefit from two large recent appropriations by the Taiwanese government to develop the island country's electro-optical and software industries.

The government's appropriations include $270 million for a four-year electro-optical development project and $220 million for establishing a 30-acre software-industrial zone. The



Source: Market Intelligence Center, Institute for Information Industry (Taiwan)

software-industrial zone will be situated in Nankang, northeast of capital city Taipei. According to government sources, a U.S. company has been contracted to draft a plan for the zone, which is to be released soon. The government would not release any details on the planned electro-optical project.

Yang Shih-chien, director of Taiwan's Industrial Development Bureau, says the facilities planned for the Nankang software zone will accommodate about 5,000 software engineers and generate annual revenue of $400 million.

The software-industrial zone, expected to be operating by 1992, will be rented or sold at prices lower than market value to encourage participation, says Yang.

With that new project, Taiwan, who for years has thrived on the manufacture of PC clones, is now attempting to shift the emphasis of its industry away from hardware. Its PC industry reached a total-output level of $723 million in 1989, but sales of PC software registered only $48 million, according to a report by the Market Intelligence Center at the Institute for Information Industry, a Taiwanese government-sponsored research institution.

During a recent visit to Boston, K. T. Lee, senior adviser to the president, said Taiwan should strengthen its software development in order to maintain the competitiveness of its computer industry. Lee was Taiwan's minister of economics through the 1950s and is considered chief architect of Taiwan's booming economy.

The move is much needed. Since 1988, Taiwan's computer industry has been suffering from a 15% annual wage growth. That, along with the island's double-digit inflation, has kept down PC makers' profit margins, which average only about 3%, according to Ta-lin Hsu, president of Hambrecht & Quist Taiwan, a Taipei-based high-tech venture fund.

"In order to maintain profitability, the Taiwan computer companies are forced to upgrade their products," says Hsu. "Software development is certainly one way to do it."

According to Hsu, Microsoft Corp.'s Windows graphical software environment is the hottest technology in Taiwan. Microsoft has recently signed a contract with Taiwan's Institute for Information Industry to run a training program on Windows 3.0, the latest version.

XIONG XIAOGE

SOFTWARE

Operating system rivals step up recruiting

NOW THAT THE OPEN Software Foundation's OSF/1 operating system has been released, OSF and rival Unix International (UI) appear to be stepping up their efforts to attract converts to their respective causes.

"We believe we have already achieved a momentum, as far as OSF/1 is concerned," OSF president David Tory said in an October press conference marking the operating system's formal debut. Not surprisingly, the OSF/1 unveiling included endorsements from OSF founders Digital Equipment Corp., Hewlett-Packard Co., IBM, Groupe Bull, Hitachi Ltd., and Siemens AG. But OSF also trumpeted support from hardware and software vendors like Intel Corp., Informix Software Inc., Intergraph Corp., and Encore Computer Corp. OSF's membership roster now numbers over 200.

One week later at the Unix Expo trade show, UI held its own press conference to tout the broad acceptance of Unix System V Release 4.0 which has been available for a year. Noting that there are now 750 products based on System V, Release 4.0 from 320 vendors, UI president and chief executive Peter Cunningham said: "The market growth is clearly with Unix System V. It is real, and products are shipping." UI's membership now totals over 180 and the press conference included endorsements from Dell Computer Corp., Fujitsu Ltd., Lotus Development Corp., and NCR Corp. NCR is also a member of OSF, but the Dayton, Ohio, company favors Unix System V over OSF/1, said Van Aggelakos, NCR's multi-user products division vice president.

But all this may not benefit computer users, concludes a recent report from Forrester Research Inc., a Cambridge, Mass., market research firm. The report says that standards organizations like UI and OSF are dominated by competing vendors more concerned with protecting their installed bases rather than delivering true standards that would allow users to easily build and operate multivendor computer networks. The report predicts that future standards will result from broad-market acceptance of existing products, rather than being promulgated by organizations like UI and OSF.

RICK WHITING

PERSONAL COMPUTERS

PC downturn hits both ends of market

THERE IS NO ESCAPE for manufacturers of personal computers, whether they sell at the high end or the low end of the U.S. market. For low-end manufacturers, plummeting September sales added a sour note to an already lackluster year. At the high end, the boom appears to have peaked, with prices tending downward. Analysts at Prudential-Bache Securities have gone so far as to downgrade the recommendation on their entire PC group from "hold" to "sell."

PC unit sales in the United States dropped 25% in September, after averaging only 4% growth for the first eight months of 1990, says a recent Pru-Bache report. "With unit volumes falling and prices being cut 15% to 20% by every major vendor, we are becoming more convinced that the PC market is headed for a repeat

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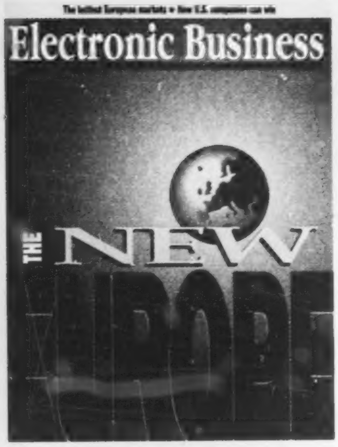

During the 1980s Europe virtually abdicated its leadership in world electronics to the United States and Japan. Today, U.S. managers are on notice that Europe is a force to be reckoned with...

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The door opens to the New Europe

Competition is on the rise as Europe approaches the Single Market, but even small U.S. players find opportunity

STAFF REPORT

Legend has it that when Columbus set sail for the New World in 1492, his charts of the mid-Atlantic carried an elaborately scripted warning: "Here there be dragons."

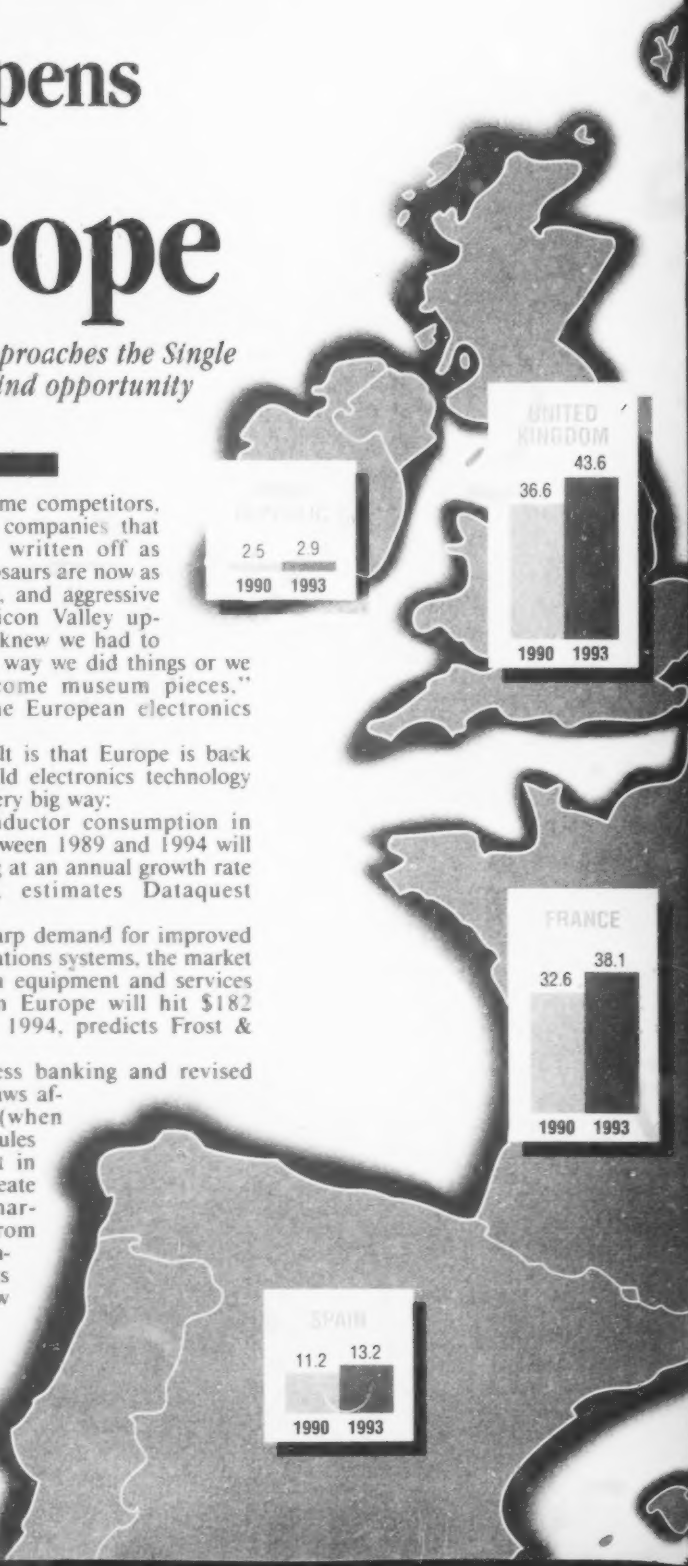
For thousands of U.S. companies struggling to identify business opportunities in the Europe of the 1990s, dragons aplenty still lurk in those depths. One might argue that the region known as Europe has been rocked by more grassroots political, sociological, and economic changes during the past decade than during any other period in recent memory. From Britain in the west to the Urals in the east, the result is a spirit of self-confidence that hasn't been seen in 50 years. Just below the surface, however, one senses the single condition most feared and abhorred by business—uncertainty.

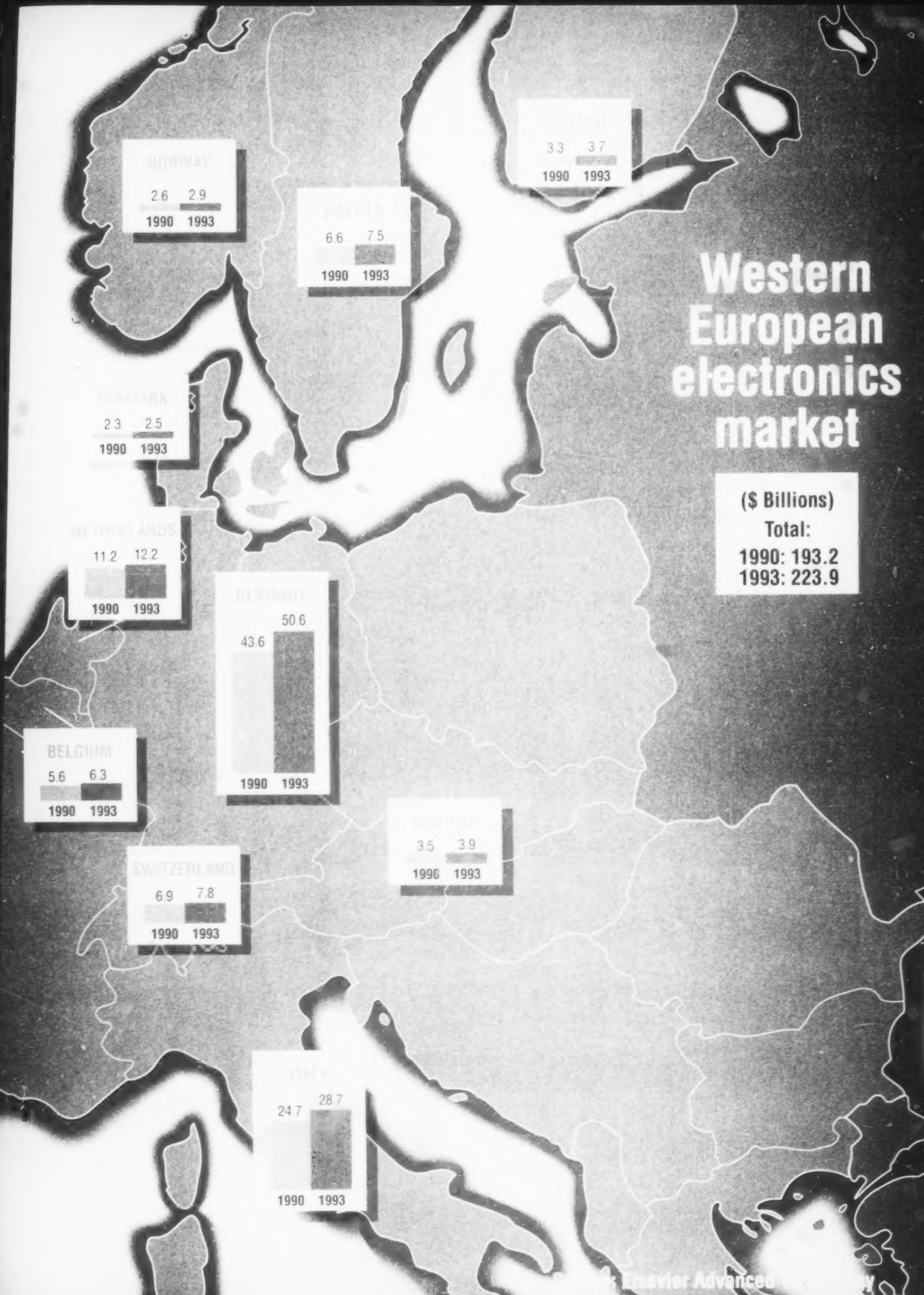
Consider that just three months ago, Germany was a politically and economically divided nation. Barely a year ago, Eastern Europe was essentially a collection of Third-World economies ruled from Moscow, itself now in the throes of the most startling upheaval since 1917. And less than a decade ago, Western Europe was gripped by a systemic economic and technological malaise—*Eurosclerosis*, some wags called it—that forced some of the world's most powerful electronics companies to virtually abdicate leadership in world markets to the United States and Japan.

Since then, Western Europe has seized a commanding position in the world electronics market. Spurred by their governments into collaboration with one-time competitors, electronics companies that were once written off as stodgy dinosaurs are now as lean, mean, and aggressive as any Silicon Valley upstart. "We knew we had to change the way we did things or we would become museum pieces," reflects one European electronics executive.

The result is that Europe is back in the world electronics technology race in a very big way:

- Semiconductor consumption in Europe between 1989 and 1994 will sizzle along at an annual growth rate of 17.9%, estimates Dataquest Europe;
- With sharp demand for improved communications systems, the market for telecom equipment and services in Western Europe will hit $182 billion by 1994, predicts Frost & Sullivan;
- Borderless banking and revised financial laws after 1992 (when the final rules will be put in place to create a single marketplace from the 12 member nations that now

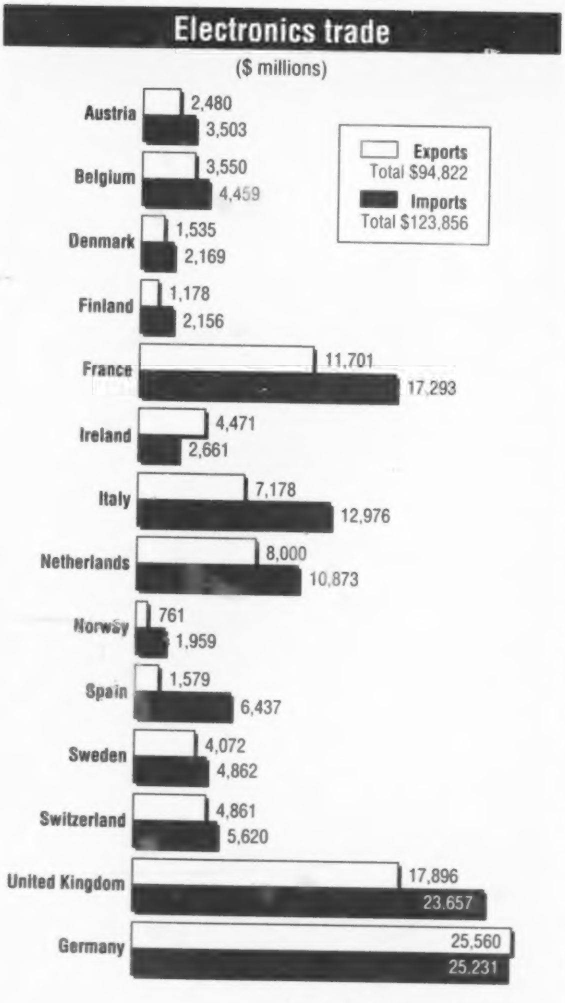



NORWAY
2.6 2.9
1990 1993
3.3 3.7
1990 1993
6.6 7.5
1990 1993
2.3 2.5
1990 1993
NETHERLANDS
11.2 12.2
1990 1993
43.6 50.6
1990 1993
BELGIUM
5.6 6.3
1990 1993
3.5 3.9
1990 1993
SWITZERLAND
6.9 7.8
1990 1993
24.7 28.7
1990 1993

Western European electronics market

($ Billions)
Total:
1990: 193.2
1993: 223.9

Elsevier Advanced



Source: Elsevier Advanced Technology

make up the European Community, or EC) are boosting demand for data processing and computer power. The European market for customer service and support alone will grow at an annual rate of 11.4%, hitting $38 billion by 1994, estimates The Ledgeway Group in Boston.

In addition, Europe outpaces the United States in the adoption of certain emerging technologies of the 1990s. By 1995, for example, Europe will have introduced hardware and broadcasting in high-definition television. Several commercial projects already have begun to implement the integrated services digital network (ISDN) technology in Britain, Belgium, France, The Netherlands, and Germany. A centerpiece of digital cellular technology—the pan-European Digital Cellular System—will be in place by 1992. Also slated for 1992 is a working cross-border beeping system, called the European Radio Messaging System.

How are executives to interpret and respond to what could well be the most extensive, wrenching, and confusing changes in the European landscape in recent history? How can any corporate planner formulate sound long-term business decisions in view of the fact that many of those changes still defy description and analysis and will themselves lead to even more changes?

Many managers, it seems, choose to simply ignore the whole idea of 1992. For them, Europe is either an incomprehensible puzzle or a faraway region with little or no bearing on their businesses. "I see very little understanding or interest about Europe among small and midsize U.S. companies," says F. J. O'Rourke, managing director of the Eurostrategies Institute Inc. in Boston. "They are only vaguely aware that something is happening over there."

O'Rourke's perceptions are reinforced by a recent survey of 3,000 CEOs of non-*Fortune* 500 companies, conducted by Access Opinions Ltd. in London. In that survey, 48% of the respondents admitted being confused about the implications of 1992 for their companies.

A merger of 12 nations

There is plenty to be confused about. Aside from the 1,500 or so formal specific rules and regulations that will lead up to the 1992 unification, in fact, no one really knows what the New Europe will look like—or even sound like. "The only thing I know is that the language of Europe will be broken English," says consultant Charlie Thayer of European Marketing in Chevenoz, France.

The principle, though, is simple enough: On January 1, 1993, the EC will become a unified trading bloc of some 325 million people, much as the United States is a single trading bloc; the new improved economies of scale and the elimination of multiple standards will boost the EC's gross domestic product by about 5%, according to a 1988 study. The grab bag of 12 separate sets of national statutes—covering such diverse matters as life-insurance policies, worker protection, product advertising, highway safety regulations, and television programming—will be replaced by a single set of national laws. For non-European electronics companies, the unification will also mean that any product or system that meets specifications in one of the 12 countries will automatically meet the specs of the other 11.

But in most outward respects, Europe won't change at all. Popular perceptions aside, unification will not suddenly introduce a single European currency; in fact, there is no such provision in the 1992 agreement. It most definitely will not end the cultural, political, and sociological differences that have divided Europe for centuries. The fundamental gulfs between France and Britain, or between Germany and Italy, are every bit as difficult to bridge as those between a Wall Street stockbroker and an Iowa farmhand.

The message is that non-European companies marketing or expanding in Europe must carefully study the differences in purchasing criteria from country to country—even from region to region in the same country. "Just try and sell in France with a technical sheet that is not in French," says one source. And personal computers, widely used by many top European managers, tend to be shunned by high-ranking German executives. "Having a PC suggests you are not important enough to have a secretary," says Albrecht F. Doehler, executive director of Siemens AG's data and information group in Munich. Even local work customs can alter a company's strategy. NEC had to abandon its expansion plans in Ireland when the "bicycle radius" limited their plant to 200 employees—the number of workers who lived close enough to bike to work.

The moral is that "American suppliers must adapt in terms of product offering," advises Vittorio Levi, executive vice president of Nokia Data Systems AB in Stockholm. "U.S. companies believe the dealer and value-added resellers are the same in each country, or that all the banks are the same. That isn't true. Everything will come together in the next decade, but it will be a long process."

Another source of confusion, if not anxiety, among American managers is the perception that the New Europe will be a highly protected market. To be sure, market unification was intended to benefit Europeans rather than Americans or Japanese. Nor can one deny that inherent cultural differences may in fact be tacitly protectionist. German electronics companies are unlikely takeover targets for foreigners, for example, since families or friendly institutions hold 56% of all shares in Germany's listed companies.

But most Europeans, perhaps taking a tip from the fallout of the bitter trade wars between Japan and the United States, claim to have committed themselves to the creation of a genuinely open unified market. "It is political suicide to admit to protectionism here," says Dean Strausl of Eurasem, a semiconductor test and assembly facility in Nijmegan, The Netherlands. "It is like admitting to adultery in Connecticut."

Indeed, Europe has already seen the erosion of government support for certain highly protected industries (although a few noncompetitive sectors might enjoy some national support for a few years yet). The European Commission, abandoning its earlier protectionist posture, has recently considered cutting import duties on semiconductors from 14% to 9.2% and removing the 5% duty on computers. In Germany, the legal standards for beer purity—reportedly the oldest single law in the world—have been revised because the Commission ruled them anticompetitive. Also in Germany, the close, century-old relationship between Siemens and the postal service failed to head off a multibillion-dollar contract last year between the service and a consortium of non-German companies.

While large multinational electronics companies such as IBM and Digital Equipment have been selling in Europe for years, it is the smaller companies that now are researching strategies of their own. For most, the question is not whether or not to take part in the changing European marketplace, but to figure out the most efficient and least risky route.

Fortunately, many of the obstacles that may have restricted such moves just a decade ago have fallen. The transformation of Europe's industrial base, the implementation of the Single Market of 1992, and the invasion of European markets by large multinationals have smoothed the bumps for smaller companies trying to stake out their own territories. "After years of takeovers and joint ventures, the multinationals have made the first round of structural moves in Europe," says Rod Dowler, chairman of the high-technology practice of KPMG Peat Marwick McLintock in London. "This has changed the pattern of the market for the next-tier players, so the market now is more competitive for midsize companies." As a result, Europe is no longer closed to outsiders—not to Japan's new jobs and technologies, and especially not to the Americans' high energy levels, innovative marketing skills, and similar political and cultural roots.

Twelve nations, one market

Founded in 1957 by the Treaty of Rome, the European Community now includes the following nations:

- Belgium
- Denmark
- France
- Germany
- Greece
- Ireland
- Italy
- Luxembourg
- The Netherlands
- Portugal
- Spain
- United Kingdom

By most accounts, the simplest and perhaps least complicated way to get started in Europe is to find an experienced distributor or agent. In this case, the U.S. Department of Commerce is one of several invaluable resources, matching small U.S. companies to compatible European customers and distributors for a modest fee.

But most experts argue against attempts to serve the European market entirely from the United States. "Anyone trying to compete in Europe from outside of Europe is at a definite disadvantage," says Eurasem's Strausl. Companies with the necessary resources are urged to set up or acquire a plant as a foothold then gradually increase the plant's design, support, and research and development capabilities. "That has been Japan's strategy in Europe, and Japan isn't known for making mistakes about the future," says Eurostrategies' O'Rourke.

Another approach is to identify and develop one of the hundreds of unattended niche markets that are appearing in Europe as large computer and telecommunications companies nail down contracts and joint ventures with their European counterparts.

Osicom Technologies Inc., for example, has eschewed conventional large markets within the EC to seek out shares of such developing European markets as Greece, Portugal, and Scandinavia. Rather than go head-to-head in Germany with huge German competitors, says marketing manager Michael Connolly, "it makes more sense to go into a small market, such as Greece, and get instant success." The Rockaway, N.J., company designs, manufactures, and distributes its personal computer systems and peripherals from Cardiff, Wales.

No one discounts the economic risks and hardships entailed in moving a business into the New Europe. But thousands of U.S. companies of all sizes will testify that the perils of exploration are far less intimidating than the penalties of global isolation. "No geographical region can be self-sufficient in everything," says Jens Uwe Fuhrmann, managing director of a leading German trade association in Munich. "We need full collaboration all over the world." □

Compromise is the key to lobbying in Brussels

Media blitzes and campaign cash may get results in Washington, but U.S. companies need more genteel ways in Europe's capital

BY LINDA BERNIER

Two years ago Jack J. Valenti, president of the Motion Picture Association of America, stormed into the so-called capital of Europe in an outrage. European Community legislators were meeting in Brussels to study a directive requiring that the majority of programs used by European broadcasters be made within the EC. The provision would slash U.S. film and TV exports to Europe—which amount to $700 million a year—by half.

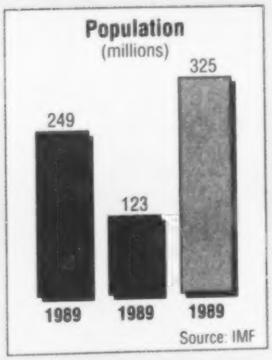
Valenti did what any powerful industry representative would do in Washington: He gave some of the local bigwigs a piece of his mind, publicly berating EC lawmakers for creating a protectionist "Fortress Europe" and threatening to call for international action against restrictive trade policies.

All that bluster might have played well on Capitol Hill, but it flopped in Brussels. Valenti made his points too loudly, too late, and—according to some critics—to the wrong people. The directive was adopted, although the obligation to progressively achieve majority European programming was not legally binding. "Valenti actually helped bring about that directive by scaring some European producers out of their minds," says one official of the European Commission, the EC's executive body. In this case, he explains, the big-stick approach merely convinced some hesitant European filmmakers and government officials of the need to protect their industry from U.S. domination.

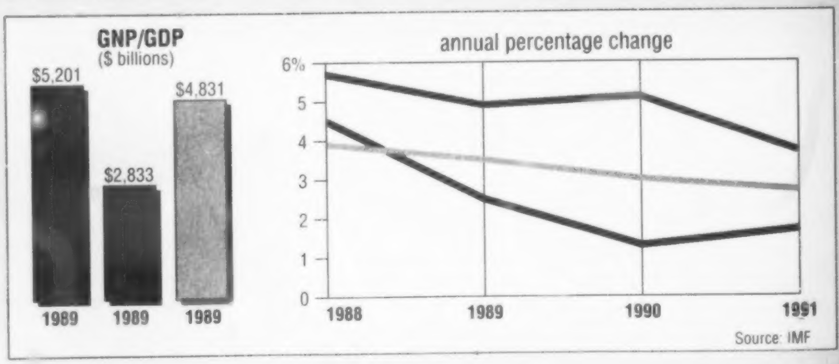
The tale may be an extreme example, but it does highlight the differences in both substance and style between U.S. and EC lobbying. Indeed, lobbying is somewhat of a dirty word in Brussels, partly because of the EC's diffuse and complicated decision-making process. In the United States, the separation of legislative and executive powers is relatively distinct; interest groups can pressure elected officials with the lure of votes and campaign support. But that isn't the case within the EC.

"In Europe, determining where the power lies is a complex exercise," says Symon Visser, IBM's director of external programs/Europe. Representatives of the 12 sovereign states that make up the European Council have the power to adopt legislation. But legislation is proposed, drafted, and administered by the Commission, a permanent body of European civil servants that owes allegiance to no single member state and is

The Big Three: Vital statistics for the U.S., EC, and Japan



Source: IMF



Source: IMF

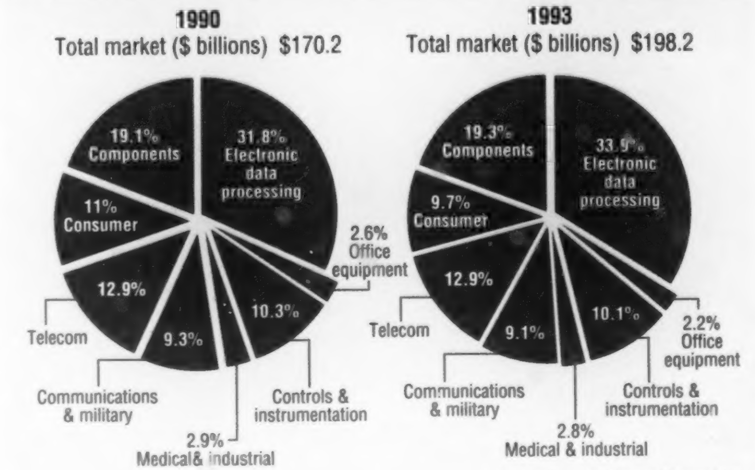
headed by 17 government-appointed commissioners.

The 518 members of the European Parliament, elected directly by citizens of the member states for five-year terms, have limited legislative powers. Although the EP must be consulted and can delay and amend legislation, the Commission does not have to accept its amendments. In fact, the Council can overturn a Commission proposal after a second reading by the EP only if it votes to do so unanimously.

Democratic accountability—which is currently an elusive concept for EC institutions—is likely to get a boost this month, however, when the EC's conference in Rome on institutional reform considers proposals to increase the powers of the EP. The proposed changes would empower the EP to elect the Commission president, oust individual commissioners, initiate legislation, and send amendments directly to the Council for acceptance or rejection, allowing them to bypass Commission intervention.

This kind of democratization would increase the power of European lobbyists and consultants, who have been flocking to Brussels since the adoption of the Single European Act in 1986. Companies that are afraid of being locked out of the EC market are increasingly turning to these specialists in order to take advantage of the opportunities deregulation will bring, and to keep up with the sheer volume of legislation—some 282 legislative proposals altogether, 60% of which have already been adopted by the Council.

The EC electronics market

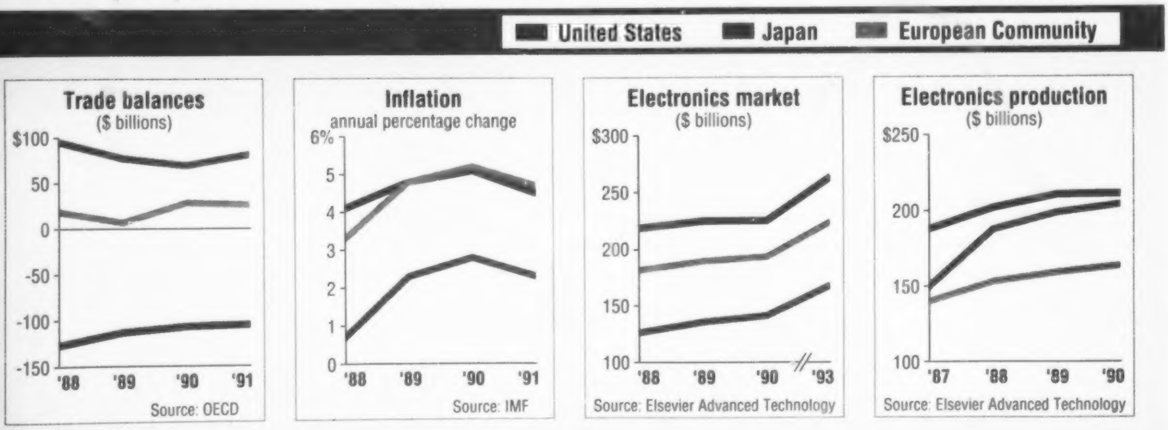


Source: Elsevier Advanced Technology

These measures have wide-ranging impacts on the electronics industry. A 1987 EC report on telecommunications, for example, led to directives that opened up the terminal equipment, services, public-procurement, and receiving-antenna markets and established the European Telecommunications Standards Institute and the open network provision directive. A 1988 paper on copyrights produced directives on the legal protection of computer programs and databases. There also are directives providing for pan-European mobile telephones, the development of an information services market, and high-definition TV. Other decisions address the financial, corporate, trade, and social fields, as well as the Commission-sponsored research and development programs that directly affect electronics.

The Commission is planning, for example, to link vital public-sector computer systems in such fields as police, customs, and treasury information. Called the European Nervous System, it is seen as an essential element in administering the Single Market program.

The EC's interest in promoting high-tech investments is evident in the Commission's Eurotech Capital and Seed Capital programs founded in 1988. Eurotech Capital is expected



Source: OECD

Source: IMF

Source: Elsevier Advanced Technology

Source: Elsevier Advanced Technology

to invest in five companies a year. The Seed Capital program provides financial investments to private seed investors for an advance payment for operating expenses. In addition, the Strategic Programme of Innovation and Technology Transfer (Sprint) and the European Strategic Programme for Research in Information Technology (Esprit) bolster European development efforts.

European Commissioner Michel Carpentier calls for an industrial policy of cooperation in a liberal market

Today, faced with increasing competition from Japan, a depressed European electronics industry, and an imminent open and liberalized single market, Commission officials are conducting the most intensive evaluation in years on how to revive this ailing sector. Europe's deficit in electronics trade is $6.5 billion with the United States and a whopping $15.4 billion with Japan.

The situation is worrisome but by no means desperate, says Michel Carpentier, the veteran Eurocrat who heads directorate-general XIII (the body responsible for telecommunications, information industries, and innovation). Carpentier predicts that Europe will find its own road between America's spirit of venture capitalism and Japan's tight industrial-policy system. "I have nothing against industrial policy if that means allowing companies to cooperate and develop in the context of a liberal market," he says. European industry, he adds, is technically equal and even superior to industries abroad in such fields as software and computer-integrated manufacturing. Further, European demand is growing more rapidly than demand for electronics in the United States, and the percentage of that market supplied by European companies is increasing, at 39% after slipping to 35% in 1985, says Carpentier.

To keep up with all the legislative and policy changes, as well as contribute to them, over a dozen top U.S. electronics companies have established or beefed up special EC affairs staff. They include IBM, AT&T, Digital Equipment Corp., Unisys Corp., and Intel Corp. Many have also joined European industry associations, such as Eurobit (European Association of Manufacturers of Business Machines and Information Technology Industry), the European Electronic Components Manufacturers Association, or the European Telecommunications and Professional Electronics Industry. Some participate in the highly regarded EC Committee of the American Chamber of Commerce. And some are pushing the American Electronics Association to open an office during the first quarter of 1991.

Some EC officials concede that U.S. companies can teach Europe a thing or two about lobbying

EC officials say U.S. companies still have a lot to learn about how to exert influence in Brussels. The methods used there are more subtle and less confrontational than in Washington. Many Eurocrats are, or will soon become, true European idealists fully dedicated to the EC's supranational goal. And since most receive salaries commensurate to those in industry, junkets and other attractions offered by lobbyists have little lure.

Foreign attitude

In many European countries, industrial policy is almost a given rather than an embattled concept. The U.S. antitrust attitude is foreign to Europeans, and Europeans and their governments are somewhat resentful of the Commission's newly acquired power to rule whether acquisitions or mergers are anticompetitive.

Americans "don't really understand the EC machinery," says one EC official. "In the United States you fight and you win. Here you discuss and you compromise." He recalls the gaffe that IBM made about 10 years ago by attacking a Commission antitrust action against the company. "The attack was politically a bad move because they couldn't negotiate anymore."

Still, some EC officials concede that U.S. companies can teach Europe a thing or two about lobbying. Long years of experience have made Americans savvy about how to organize and present views in ways that are digestible to understaffed and overworked civil servants. U.S., in addition to Japanese, companies are astute about playing one European country against another, especially in cases where big corporate investment, employment, and tax revenue makes government officials more sensitive to their points of view. European companies, long used to their positions as "national champions," often don't see the need for aggressive lobbying tactics.

For example, during the initial hearings on the software protection directive, not a single company brought up the now hotly contested issues of reverse engineering or interoperability. "Where was the European lobby—Siemens, Philips, and ICL—then?" according to one EC official. "We were waiting to hear from them." ☐

A sluggish economy trims demand for electronics

But there are plenty of longer-term prospects for success if companies can ride out Britain's grim economic climate

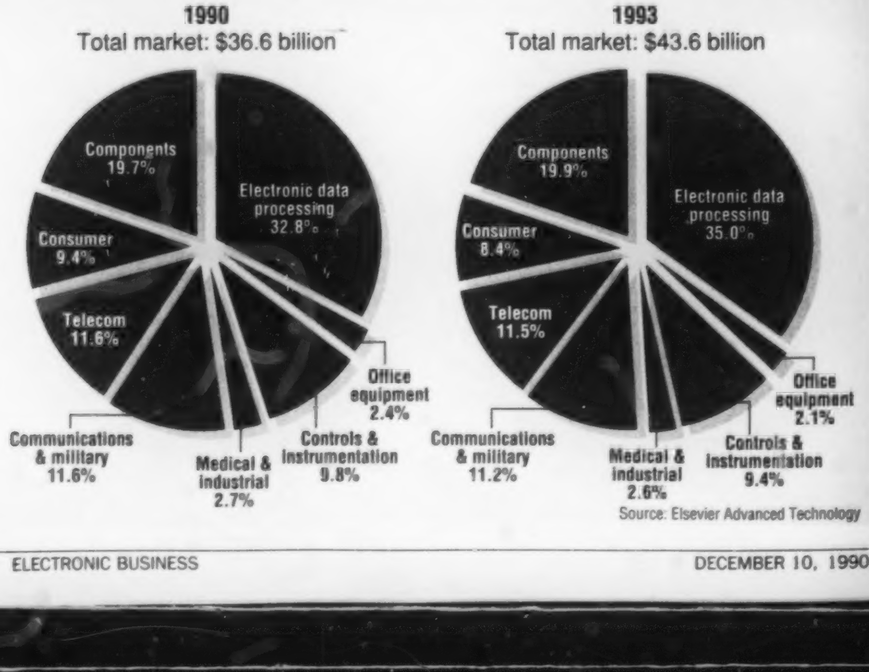
BY BARBARA N. BERKMAN

Double-digit inflation and high interest rates have dimmed the immediate outlook for semiconductors, passive components, and value-added computer-related products in the United Kingdom. Although the telecommunications sector looks relatively solid for now, overall growth in electronics during the next year or so is estimated to come in at about 5.4%, predicts Peter Sachs, director general of the Electronics and Business Equipment Association in London. That is a significant drop from the historical annual growth rate of 8%.

Especially hard hit are computer companies that sell to London's financial institutions. Los Angeles-based Teradata Corp., for example, attributes its third-quarter loss partly to significantly slower U.K. sales of its mainframe-class database computers. The moratorium on defense-budget increases have added to the industry's losses. The Ministry of Defense spends about one-third of its $14 billion budget on electronics equipment or systems, estimates analyst Sash Tusa of Robert Flemings Securities Ltd. in London.

So far, though, the downturn hasn't deterred U.S. electronics companies from using Britain to launch their European operations. The British electronics market, after all, is still the second-largest in Europe, after Germany, with 1990 sales estimated at $37 bil-

United Kingdom's electronics market



Source: Elsevier Advanced Technology

lion. And for English-speaking newcomers to Europe, the shared language and common business practices make the U.K. an easier place to do business than, say, France or Germany.

Steady investment by U.S. and Japanese companies over the past few years has significantly beefed up the nation's production base. The flow of manufacturing into the U.K. has already created niches of opportunity for growth, even in a recession. Plessey Semiconductors Ltd. in Swindon, England, for example, struck a deal worth $20 million with Conner Peripherals Inc.'s operation in Scotland to pursue the growth niche of mass-storage disk drives. "We have grown from zero to $50 million in that business in 18 months," says Ray Gleason, Plessey's worldwide marketing manager. Plessey earns 33% of its sales in Britain. While the company reports a slowdown of new design wins, sales are somewhat protected because one-half of its business is in semicustom chips, mostly for ongoing projects.

Still, most electronics companies based in Britain are being pinched. A July survey by the Confederation of British Industry (CBI) in London revealed that 75% of electronics goods manufacturers reported below-normal orders and expected the trend to last through October. "Business is difficult and will likely remain so," says Ted Merrette, managing director of AB Electronic Products Group, a Welsh components maker with 1989 sales of $468 million.

The British electronics market is not without its bright spots. Some 95% of the electronics industry consists of U.K.-based multinational giants that post sales of more than $180 million, export mostly to the rest of Europe, and so rely less on domestic revenue. And because of the falling value of the dollar, U.S. companies that distribute, rather than manufacture, in Britain are also doing relatively well. "Britain is a hotbed of activity for us," says Bruce Earl Goguen, president of Goguen Industries Inc. in Liverpool, N.Y.

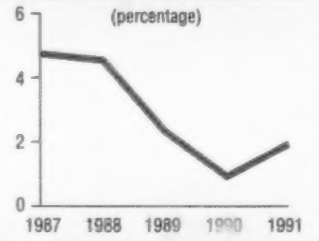
For most companies, success in Britain is simply a matter of waiting out the current economic downturn. In defense electronics, for example, "every major defense program is going to suffer in the short term," says Stuart Exell, managing director of BBN Systems & Technologies based in Edinburgh, Scotland. According to another source, some 2,500 defense-electronics research jobs were axed in Britain during 1990. Still, the segment features a few relatively secure niches, such as electronics equipment for upgrading weapon systems, surveillance and communications electronics, and simulation equipment for training military personnel.

United Kingdom

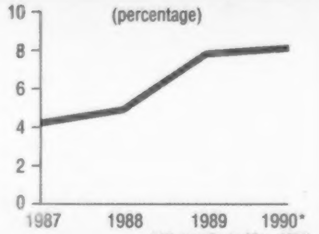
Land area: (sq km)	244,493
Population: (1989)	57.2 million
Civilian employment: (1989)	28.1 million
GDP per capita: (1989)	$14,580
Number of electronics companies:	360
Total electronics employment:	541,000

Source: British Information Service

United Kingdom GDP growth

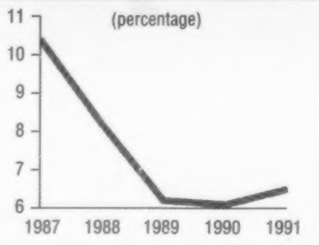


Consumer price index



*12 months to Mar. 1990

Unemployment



Source: OECD

A similar situation prevails in telecommunications. British Telecommunications plc, the top domestic player, is now undergoing a cost-cutting retrenchment by slashing 10,000 jobs and reducing inventory levels. By 1994, however, Britain's market for telecom services will grow from $19.9 billion in 1990 to $24.7 billion, according to Frost & Sullivan in London. During the same period, the telecom-equipment market, now at $7 billion, will hit $9.3 billion. Meanwhile, shipments of LAN nodes will grow from 556,365 units this year to 896,340 by 1995, according to International Data Corp. in London.

Britain's semiconductor consumption will grow from $2.7 billion in 1990 to $6.1 billion by 1994, predicts Dataquest Europe. Indro Mukerjee, marketing manager for Hitachi Europe Ltd., estimates the U.K. mass market for chips is the largest in Europe, with the top 100 customers representing about 40% of the market. That leaves chip companies and distributors catering to a mass of small accounts.

Britain is also home to a strong components industry, with a positive European Community trade balance for capacitors, discrete components, printed circuit boards, and resistors. By 1993, the British market for those components will reach $6.9 billion, according to the National Development Council's Electronic Components group in London.

Another important economic factor is Britain's entry in October into the EC's European Monetary System, a move that will cut the nation's high inflation, interest rates, and wages—factors that directly impact U.S. electronics companies that sell or manufacture in Britain. When Chancellor of the Exchequer John Major pushed Britain into the system, he took a big step toward monetary unity and a single currency for the entire EC. While Britain's participation in the EMS won't make much short-term difference, it will eventually cut the cost of capital and stabilize the British pound against European currencies. "It will create a better investment climate in the next three to four years," says Sudhir Junankar, head of economic trends at the CBI. ☐

An irresistible market, but no place for the novice

At once cosmopolitan and provincial, France is a rewarding European base for companies that invest the time and resources

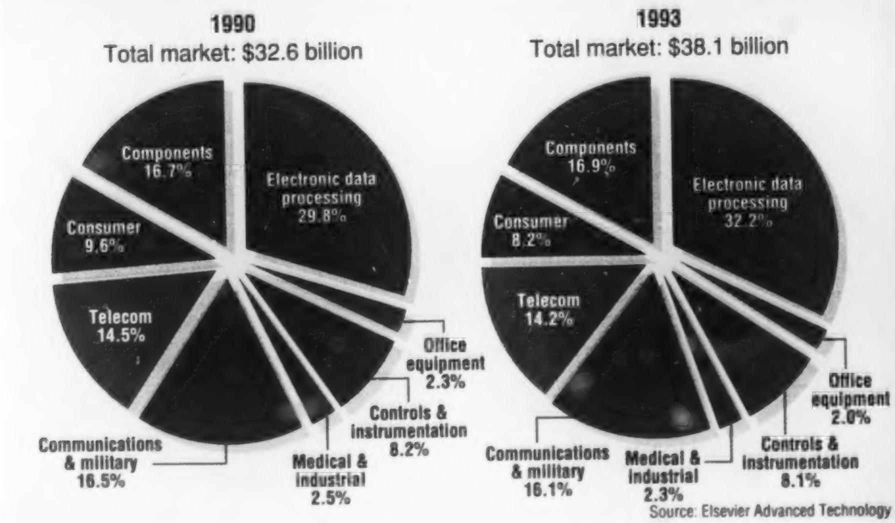
BY TERI SPRACKLAND

France is both alluring and intimidating to U.S. electronics companies. A $32.6 billion market that enjoys a strong lead in telecommunications, a rebound in consumer electronics, and a strong showing in computers, France provides a home away from home to many multinationals. Yet national champions still gain much government support, and institutional and language barriers remain strong.

As electronics companies set up shop in France, they should look to the example of those already in place and be prepared to invest years in the process while becoming part of the local landscape. Unless there is an overwhelming synergy, France is likely to prove a poor first choice for smaller U.S. electronics companies. "France is not the spot for first-timers," warns Ronald Blunden, senior vice president of Thomson Consumer Electronics. Noting the broad disagreement between France and other European Community members on the subject of foreign investment, he notes that the barriers to invest are much lower in Britain, Ireland, and Spain.

Assuming a good market, however, the choice may be inevitable. Many U.S. computer companies would not have posted recent profits without the aid of their European subsidiaries, most of which are active in France. U.S. electronics companies already employ more than 60,000 people in

France's electronics market



Source: Elsevier Advanced Technology

France, according to the French Industrial Development Agency. The nation has attracted most of the big names among the long-established multinationals. IBM France is the fifth-largest company in France and some say the most profitable. Hewlett-Packard recently decided to move its global PC headquarters to Grenoble. Other U.S.-based companies in France include General Instruments, GTE, AMP, AVX, Vishay, Sun Microsystems, and Texas Instruments.

Having closely watched the battles between U.S. and Japanese multinationals, the French most fear a Japanese invasion of Europe that could overwhelm their local industries. The acquisition by Fujitsu Ltd. of the British computer company ICL plc has become a *cause celebre*. "The concept of a national computer industry may cease to exist in Britain because of this acquisition, and it is important that France avoids finding itself in the same situation," says Jacques Bouyer, president of Groupement des Industries Electroniques (GIEL), a leading French electronics industry association.

After several years of restructuring, the French electronics industry is pushing strongly for leadership in Europe and the world. French electronics exports totalled more than $24 billion in 1989, up nearly 10% from the year before.

France has digitized about 70% of its telecommunications network, with ISDN technology in some areas. Telecommunications owes much of its strength to Minitel. Initially funded by the government with the idea of putting electronic telephone directory services in the home, the Minitel videotext service eventually paid its way only when sexually explicit *messagerie rose* were allowed. This type of messaging allows anonymous user groups to communicate and has been linked with prostitution. Concerns have been raised over access to the technology by minors. Nevertheless, the Minitel project helped make France a world leader in videotext services.

In consumer products, the glory of France is being pinned to the development of a standard for high-definition television (HDTV—or TVHD, as it is called in France). Here, Thomson Consumer Electronics is becoming a global contender by capturing 22% of the U.S. television and 15% of the U.S. VCR market with its purchase of RCA from General Electric. HDTV standards issues are being addressed through an EC program called Eureka 95.

In computers, the U.S. giants have been leading the parade in France for some time. In fact, the multinational computer companies have found their European subsidiaries' sales to be outdistancing U.S. growth. France ranked just behind Germany in 1989 in the acquisition of business computers, with PC sales at 770,000 units in 1989, according to market researcher International Data Corp., France. A 10% growth rate is predicted through the end of this year.

The use of PCs is filtering down to smaller business, and the top three U.S. companies—IBM, Apple Computer Inc., and Compaq Computer Corp.—control more than one-third of the market, according to Dataquest. Apple has taken market share away from IBM for several years. In fact, Apple honchos brought European operations chief Michael Spindler back to home base to see if he can work the same magic on the U.S. market.

Paris's reputation as the only place to do business in France is fading. Some time ago, the French government forced the relocation of several key professional schools to other regions, a move that has had the desired effect of encouraging regional growth. A particular beneficiary has been the Alpes-Maritimes region in the south of France. This year, high-technology businesses finally surpassed tourism as the mainstay of local industry.

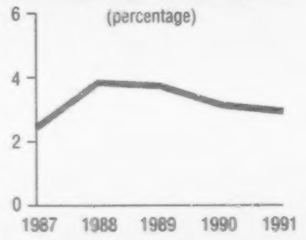
The lode star has been Sophia Antipolis, located between Nice and Cannes. Built on the firm refusal to allow messy manufacturing plants, the technology village has scored an enviable record of attracting R&D projects. Like Silicon Valley, the area features a glorious climate and astronomical housing costs. With design engineers in short supply throughout Europe, some companies find it dangerous to let engineers visit this "city of wisdom," since they may insist on relocation.

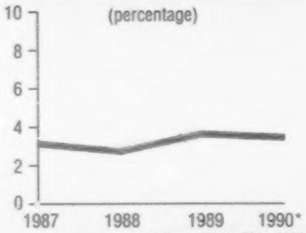
Despite an inherited aptitude for building monolithic government-supported industries, France is allowing entrepreneurs to experiment with new industries. Engineers are striking out on their own—forming small businesses and looking for niches and partnerships. However, the size of the market continues to attract outsiders. Willing or not, France slowly is abandoning the ramparts of economic nationalism. ☐

France

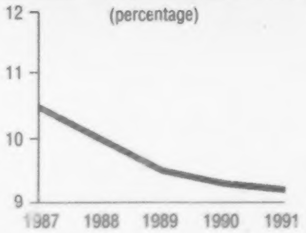
Land area: (sq km)	543,998
Population: (1990)	56.5 million
Civilian employment: (1990)	21.5 million
GDP per capita: (1990)	$17,000
Number of electronics companies:	800
Total electronics employment:	250,216

Source: French Embassy


France GDP growth


Consumer price index

*12 months to Mar. 1990


Unemployment

Source: OECD

Politics create instability in Nordic market

Ericsson, other giants threaten to leave if Scandinavian nations remain outside the European Community

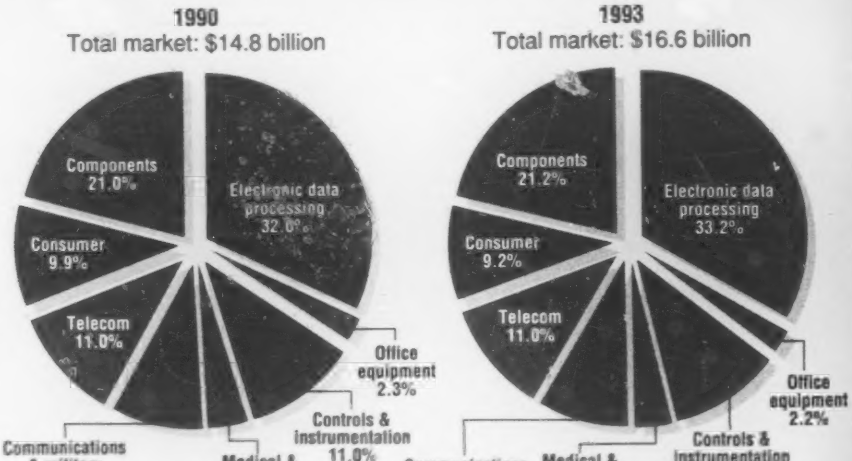
BY BARBARA N. BERKMAN

At first glance, Scandinavia might be seen as a near-perfect entry into the European electronics market. Although the market is relatively remote and only about one-tenth as large as Germany's, the four nations—Sweden, Finland, Norway, and Denmark—are far more amenable than many other European nations to outside competitors. Unlike Germany or France, for instance, the region has never been politically constrained to favor Scandinavian electronics suppliers over foreign ones.

But the picture is changing rapidly because of political and economic alliances that could have profound implications for U.S. companies. Faced with sluggish economic growth, an annual inflation rate of more than 11%, and eroding competitiveness, some Scandinavian countries—particularly Sweden, Finland, and Norway—are seeking to improve their economic fortunes by swapping their membership in the European Free Trade Association for places in the European Community. Sweden and fellow EFTA member Austria have already asked to join the EC, and Norway is expected to follow suit.

As long as Scandinavia remains outside the EC, U.S. companies can benefit from the fact that products sold in EFTA nations can be priced higher than those sold within the price-harmonized EC. As Scandinavian com-

Scandinavia's electronics market



Source: Elsevier Advanced Technology

panies move their production and research facilities into the EC, however, it is likely that Scandinavia's domestic electronics demand will dwindle.

Regardless of the outcome of the EC membership issue, the Scandinavian electronics industry seems headed for a shakeup. According to some analysts, Sweden's EC membership will force the country to abandon its full-employment policy and heavy tax laws. But if Sweden does not join the EC (or at least overhaul its tax policy), companies like $5.5 billion Telefon AB L.M. Ericsson may simply relocate along with other electronics giants, says Ericsson's chief executive Lars Ramqvist.

Until the matter has been permanently resolved, smaller U.S. electronics companies should consider keeping their options open by selling in Scandinavia without investing in an actual sales or production presence. Ericsson's New York office, for example, serves as a middleman for smaller U.S. electronics companies that have no exporting experience, says Johan Siberg, an Ericsson director. "That means you don't have to manufacture in Europe [to sell to Ericsson]." Ericsson already sources enough supplies from the EC to meet European origin requirements.

In many ways, the Nordic electronics market is similar to Germany's. Engineers from both regions have a reputation for demanding more technical information and better performance than many of their European counterparts.

Scandinavia is attractive to U.S. companies for several reasons. For one, the region's giant electronics companies, such as Ericsson, Nokia, and Norsk Data, are accustomed to dealing outside their domestic markets. Another attraction is the region's heavy concentration of electronics consumers and producers; Sweden, for example, is home to such major companies as Saab-Scania and AB Volvo (auto electronics) and AB Electrolux, the white-goods manufacturer. As for Ericsson, the company is riding a wave of growth in telecommunications with its public switches, mobile voice and data systems, and defense radio communications.

Another advantage for U.S. companies is that, although Sweden, Finland, and Norway are outside the EC, their technical standards are consistent with EC requirements. While midsize U.S. companies usually look first to the heart of the EC instead of Scandinavia, the latter market has fewer informal entry barriers than many EC countries, such as language or cultural bias, according to Michael Connolly, marketing manager of the U.S. company Osicom Technologies (UK) Ltd. in Cardiff, Wales.

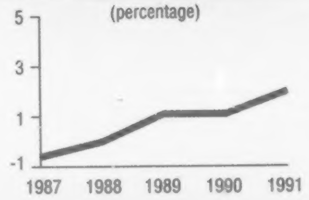
Scandinavia

Land area: (sq km) 1,153,800
Population: (1989) 22.8 million
Civilian employment: (1989) 11.6 million
GDP per capita: (1989) $21,403
Number of electronics companies: 775
Total electronics employment: 185,500

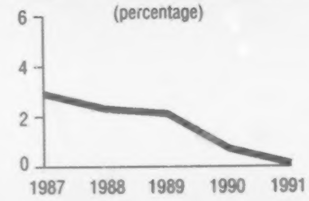
Source: ELECTRONIC BUSINESS estimates

GDP growth

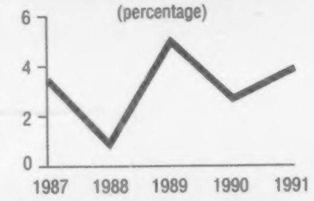
Denmark



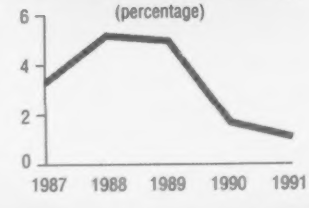
Sweden



Norway



Finland



Source: OECD

"There is no reason for [non-Scandinavians] to be bashful," explains Lars Stalberg, vice president of corporate markets for Ericsson in Stockholm. "We spend a lot of time understanding how the French, Italian, Germans, and British think." Moreover, he says, Americans are essentially exempt from the political and cultural antagonisms that so often define business relationships in Europe.

But U.S. companies shouldn't be overwhelmed by the warm welcome. While demand for sophisticated electronics is high, the market still must mature in some technologies. Unix, for example, is far less accepted in Scandinavia than in the United States. "In the commercial market, Unix is still finding its place in Scandinavia," says Stratton Sclavos, acting general manager of Mips Computer Systems Ltd. in Marlow, England. Mips recently selected a small distributor for the region after learning just how limited the Scandinavian Unix market really was.

Smaller companies are relatively rare in Sweden, partly because of the sluggish economic growth and partly because the country's corporate tax rules favor large, capital-intensive industries. The few small companies that do exist are unlikely takeover candidates for U.S. companies interested in securing an instant foothold in Scandinavia, since local laws discourage takeovers by limiting foreign ownership of corporate equity.

Finally, Scandinavia is an expensive region to set up direct-sales operations: Sweden's liberal social policies and worker benefits, for example, can add 40% to salaries. Selling costs also are high. In the United States, for example, an ad in the computer-industry press could reach as many as 700,000 readers. In Sweden, "one ad reaches only about 20,000 people, so the cost per lead is much higher here," warns Tommy Palmqvist, managing director of Dell Computer Corp. in Sweden. ☐

Germany totes up cost of reunification

Along with some of Europe's highest electronics growth rates, the newly reunified nation also has heavy costs and a "members-only" business environment

BY H. GARRETT DeYOUNG

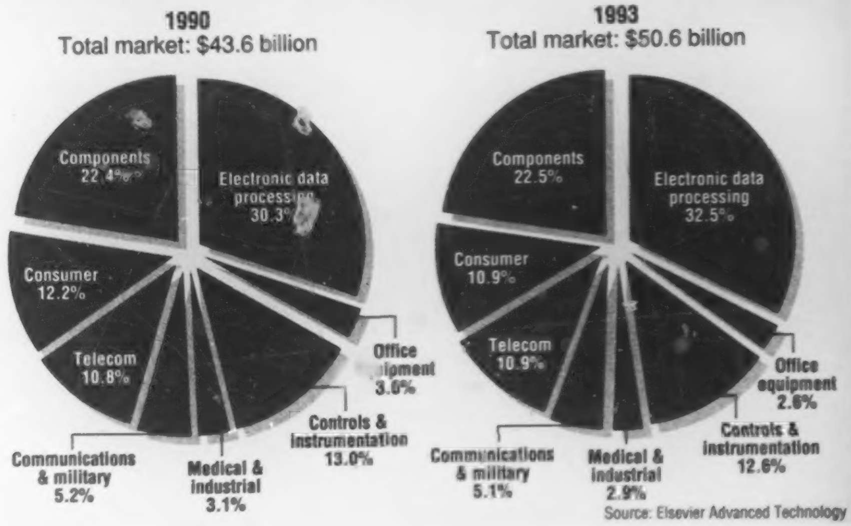
Few nations have so totally baffled the outsider as twentieth-century Germany. By turns sentimental and bellicose, solicitous and arrogant, the nation somehow seems torn between its desire to be a good neighbor in the prosperous New Europe and what one historian described as an inborn inclination to rule.

That complexity reaches into the nation's powerful industrial sector. Boasting a 1989 roster of some 1,700 electronics and electrical companies, Germany is the largest electronics producer in Europe and the third largest in the world, according to the Brussels Consulting Group in Palo Alto. For the unwary U.S. company, however, it may also be a minefield.

One reason is the German economy. With the nation's booming exports, an inflation rate of only 3%, and a personal-savings rate of 13% (two to three times higher than in the United States), German electronics seem all but immune to the slowdown now plaguing other European countries.

But there is still the matter of the massive bills incurred by the October reunification with the former East Germany. Emotional and historical impacts aside, few industry sources expect an immediate payoff from the absorption of what is essentially a Third-World nation. "It will be at least 10 years before living standards in the eastern part

Germany's electronics market



Source: Elsevier Advanced Technology

of the country reach even 75% of those in the west," says Karl Leitenberger, deputy director of economic policies at Siemens AG in Munich. Moreover, the government's repeated trips to the capital markets to finance that move have bumped up interest rates more than 2% during the past year, notes Martin Rommel, assistant vice president at Stuttgart-based Landesgirokasse, a top German bank. Other analysts predict a jump in personal and corporate taxes—now among the highest in Europe—after this month's general elections.

Nor is Germany a cheap place to do business, especially when compared with such depressed regions as Northern Ireland. The nation is famous for its superb educational system, ample supply of skilled workers, and high productivity. At the same time, though, high wages and generous worker benefits make Germany's production costs "several percentage points too high by world standards," says Adolf Ahnefeld, secretary to the board of managers at Robert Bosch GmbH in Gerlingen-Schillerhohe.

U.S. companies hoping to crack the German market on their own should also plan for a long dry spell. For all the talk of the 1992 Single Market, Germany supremely illustrates the highly localized nature of buying and selling in Europe. While Germany is a very stable market with a great deal of customer loyalty, in contrast to France or Italy, it maintains a "members-only" environment in which newcomers are held at arm's length for years, says Nick Walker, the British-born director of European marketing at Force Computer in Neubiberg. "It could take five years of talking with German buyers before you start doing business," adds Hans DeHaan, European business administration manager at VLSI Technology GmbH in Munich.

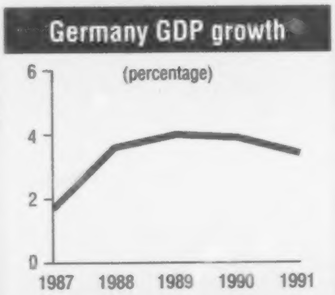
But even those caveats are unlikely to dissuade U.S. companies from climbing aboard the German electronics steamroller. One reason is the brisk annual GDP growth rate for the newly united nation, between 3% and 4% annually this year and next, says industry consultant Helga Burgstahler in Stuttgart.

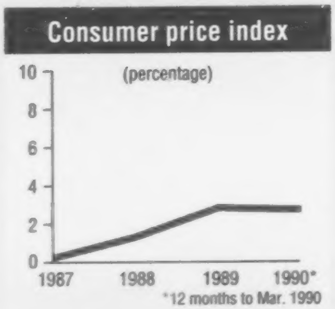
Telecommunications offers the fastest electronics growth in Germany during the next few years, partly because of the anticipated demands of the Single Market, partly because of expansion opportunities in Eastern Europe, and partly because of system privatization. The number of private networks in Germany is expected to grow 10% per year, says Wolfgang Flachmann, deputy director of private communications systems and networks at Siemens AG in Munich.

Germany

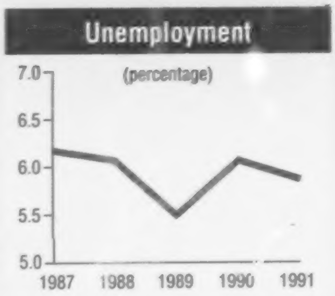
Land area: (sq km)	356,780
Population: (1989)	78.4 million
Civilian employment: (1989)	32 million
GDP per capita: (1989)	$16,200
Number of electronics companies:	1,500
Total electronics employment:	411,047

Source: German Chamber of Commerce, Elsevier


Germany GDP growth


Consumer price index

*12 months to Mar. 1990


Unemployment

Source: OECD

Perhaps the biggest telecom growth rates are reserved for cellular and mobile phones. Europe now runs about three years behind the United States in the development of that market, according to Hartmut Reuter of Bosch's corporate planning and controlling unit. And while it is now impossible to make a cross-border cellular phone call in Europe, the post-1992 Single Market will allow a cellular phone user anywhere within the European Community to call any other EC telephone.

The German electronics market is dominated by a handful of powerful companies such as Siemens, Bosch, Telefunken Electronic GmbH, and Grundig AG. But sources agree that there is plenty of room for newcomers—especially from the technology-rich United States. "Ten years ago, we thought that each European country would be strong in at least one electronics field," says Alfred Prommer of Prommer Consultants in Munich. "It now seems that was an artificial strategy. We should be doing all we can to get U.S. companies here to contribute to our overall technology."

To some observers, moreover, American companies are favored simply because they are American. The European business community is still largely fractured into "German" companies, "French" companies, "British" companies, and so on—associations encumbered with cultural and political rivalries. "An American company won't be seen that way," says Christoph Horstmann, executive director of Siemens's semiconductor group.

Still, the United States seems like a long way off to most Europeans, says Walker of Force Computer. "You can't just send over two or three people and find an office." A far better strategy is to find a local partner—a qualified sales agent, for example, or another company with a complementary technology.

For all its intimidating size and power, Germany promises a rich payback—at least for companies that do their homework, master the local ground rules, dig in for the long haul, and, most importantly, pay close attention to product quality and reliability. "If you have a good product," says consultant Burgstahler, "you will have a good market." ☐

EC's unification drives telecom and computers

Fighting off a slowdown, Italy strives to catch up with its neighbors, and with the United States, in the service sector

BY MARSHA JOHNSTON

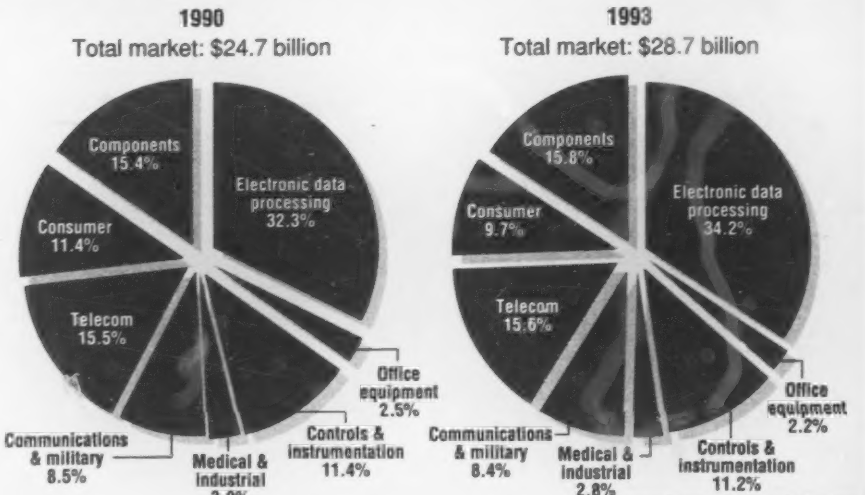
By all indications, Italy is unlikely to escape the economic slowdown that is now spreading throughout Europe in general and the electronics marketplace in particular. Still, the Italian electronics sector is expected to post a relatively healthy performance during the next year or so, especially in telecommunications and industrial automation.

Even so, U.S. companies seeking a foothold in Italy will need time, money, and plenty of patience. As in so many European countries, it is imperative to first study the regional culture and its implications for business, preferably by establishing relationships with those already familiar with the product and the market. "You must know people, otherwise you can't get through," says Elio F.C. Sasso, electronics industry analyst for the commercial section of the U.S. Embassy in Rome.

Once those relationships are established, U.S. telecom companies can expect ample payback for their efforts. "Telecom is increasing the most [in electronics]," says Marina de Mico, general manager for Milan-based distributor Ing. Giuseppe de Mico SpA. A recent report by the U.S. Embassy put Italian telecom growth at an annual rate of 14.1% in real terms at least through 1993; by then, demand is estimated to reach $8.72 million, from about $5.86 million in 1990.

Italtel (Italy's national manufacturer of

Italy's electronics market



Source: Elsevier Advanced Technology

telecom equipment), for example, expects to spend $88 million on semiconductors alone in 1991 versus this year's estimated $76 million. Meanwhile, Italy's domestic telecommunications agency (the Societa Italiana per l'Esercizio delle Telecomunicazioni p.a., or SIP) expects to invest $31 million between 1990 and 1993.

Value-added telecom services, such as LANs and ISDN, will also be in high demand in Italy. This segment of the electronics market hit $550 million in 1989, adds Sasso, and should grow threefold during the next two to three years. The reason, he says: Telecom services in Italy lag well behind those in the rest of Europe and are far less advanced than in the United States. Phone bills are not itemized, for example, and no credit is given for wrong numbers.

In recent months, the Italian government has discussed privatizing SIP and opening the network to another licensee (although no such decisions have yet been made). In a recent interview, Oscar Mammi, minister of post and telecommunications, declined to predict the complete liberalization of the mobile phone sector but did note that the sector will become more competitive. Among potential competitors to SIP are two private consortia—one that includes Ing. C. Olivetti & Co. and another that includes a top executive from the Fiat-Berlusconi group.

Indeed, the opening of the telecommunications sector is inevitable if Italy is to succeed in a unified Europe. "With European unification," says Bruno Lamborghini, Olivetti's vice president of corporate strategic analysis and planning, "you can see the possibility of reinventing [and improving] public services by using information and communications technology for integrated systems and services."

On another front, the Italian computer market was hit by last year's generally lower demand across Europe. Although Olivetti reported a 5.8% increase in turnover and pretax profits of $50.75 million for the first half of 1990, the company has been fighting the industrywide trend of eroding margins, personnel reductions, and other cost-containment measures. Last year, for example, PC shipments grew at the rate of 31.5%. The rate dropped to 23% during the first quarter of 1990 and to 16.7% during the second quarter. The third-quarter figure could come in at 10% or less, says Lamborghini.

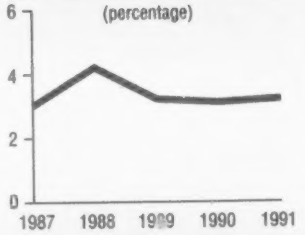
But longer-range prospects are encouraging. This year's Italian market consumed about 432,000 PCs and workstations, 44,000 minicomputers, and 900 mainframes, estimates Teknibank, a Milan-based market research firm. By 1993, Teknibank expects annual consumption to reach 582,000 PCs and workstations (a net three-year increase of 35%), 47,000 minis (7%), and 1,082 mainframes (20%).

Italy

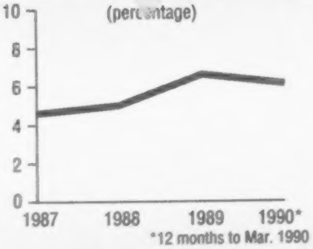
Land area: (sq km)	301,225
Population: (1989)	57.5 million
Civilian employment: (1988)	21.1 million
GDP per capita: (1990)	$18,260
Number of electronics companies:	628
Total electronics employment:	196,520

Source: Italian Trade Commission

Italy GDP growth

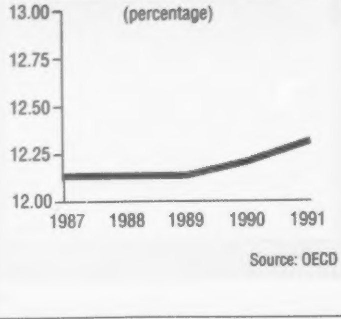


Consumer price index



*12 months to Mar. 1990

Unemployment



Source: OECD

"Olivetti is growing in PCs both in terms of units and in terms of revenue," says Mauro Righetti, senior vice president of procurement at Olivetti Systems and Networks. Accordingly, Righetti also predicts huge growth in Olivetti's consumption of components, such as 4-megabit DRAMs. The question is whether that growth will favorably affect supplier revenue, given the 40% lower prices in 1-Mb DRAMs between 1989 and 1990.

As for other components, Teknibank expects the market for connectors—including coaxial, PCB, rack-and-panel, and fiber-optic connectors—to grow about 10.5% per year for the next three years from this year's estimated $250 million. Computer and office automation represents the largest market for connectors (with 32%); public and private telecom accounts for 25% and 9%, respectively. Industrial electronics accounts for 11%, leaving 21% divided among other sectors.

Italian electronics could still be something of a pitfall for the inexperienced U.S. company. One reason is that wages in Italy run 2% to 3% higher than the European Community average, according to Confindustria, an Italian industry trade group, and have recently been rising by 7% to 10% annually.

Given the overall costs of electronics production, however, wages by themselves represent only a minor obstacle, according to Luigi Segu, external purchasing manager for Digital Equipment Corp. in Milan. A more serious problem is that excess supply in Italy makes savvy marketing even more critical to the newcomer. "It is best not to go direct," says Sasso. "You need Italian managers, even if the operation is run with U.S. capital, unless [the product] is unique. In that case you don't need anyone."

De Mico agrees with the need for insider knowledge. "In the United States, business is based more on price and delivery," he says. "But the Italian customer concentrates mostly on the relationship." ☐

Searching for paydirt east of the Elbe

The complications of setting up business in the former Eastern bloc allow little margin for error

BY H. GARRETT DeYOUNG

You needn't be a brain surgeon to come up with several very good reasons to stay clear of the Eastern European electronics marketplace, at least for the next several years.

Following the collapse of what was once the Communist bloc, most of the national economies in the region are in shambles. Inflation in Poland hit 1,000% at one point, notes one consulting firm, although it recently settled down to a mere 25%. Environmental pollution in many of the countries—parts of Czechoslovakia, for example—ranks among the worst anywhere. And even the most basic precepts of Western business are all but unknown east of the Elbe.

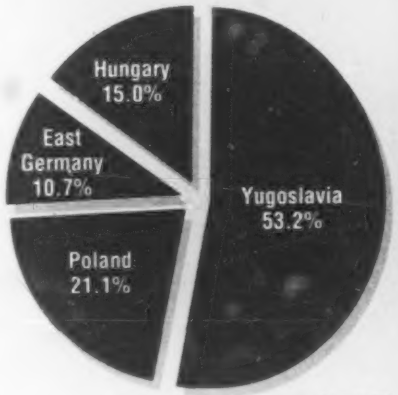
Still, more than 3,300 joint ventures had been registered in Eastern Europe by the end of 1989, according to the United Nations' Economic Commission for Europe in Geneva. As of early this year, Western companies had signed more than 740 joint ventures in Hungary and more than 1,400 in Poland, according to Harry Sello, president of Harry Sello and Associates in Menlo Park, Calif. While almost all of the Western partners are European companies (mostly German), Opinion Research Corp. in Princeton, N.J., notes that one-third of the United States' 1,500 largest companies plan to start doing business in Eastern Europe during 1991. One big reason for U.S. expansion, says Sello, is the "potential consumer and governmental market of 136 million people with over 40 years of pent-up demands and unfulfilled expectations."

If that sounds a little vague, it is because no one really knows very much about the size or the production capacities of the Eastern European electronics market. The region has no independent market-research firms such as Dataquest or Frost & Sullivan. Data that does exist has long been jealously hoarded by various ministries or manipulated by party officials. The result is that while one source claims that consumer electronics in the region could reach $38 billion by the end of the decade, one senses that an estimate half as high—or twice as high—would be just as credible.

Most analysts agree that, as in other parts of Europe, telecommunications ranks as the high-growth electronics segment during the 1990s. The existing system is widely described as dilapidated, outdated, and hopelessly inadequate, the deliberate result, by one account, of a policy by which the old Communist regimes defused counterrevolution by keeping the populace essentially

U.S. electronics exports to Eastern Europe

1989 total: $120.7 million



Source: EIA

Bulgaria

Land area: (sq km)	110,912
Population: (1988)	9 million
GDP: ($ billions, 1988)	$50.7
GDP per capita:	$5,633
Growth of GDP: (1986-88)	1.9

Source: OECD, World Almanac

incommunicado. Only about 13% of the Soviet population now own telephones, versus an average of 50% in most Western nations. Upgrading telecom in the Soviet Union and the rest of Eastern Europe will cost some $350 billion over the next decade, according one research group.

Sello notes that of the new Eastern European markets, three nations in particular—Hungary, Poland, and Czechoslovakia—represent the most significant business prospects for U.S. companies because of their aggressive moves toward Western alliances and developing market economies.

Czechoslovakia

Land area: (sq km)	127,876
Population: (1988)	1.57 million
GDP: ($ billions, 1988)	$118.6
GDP per capita:	$7,603
Growth of GDP: (1986-88)	1.5

Source: OECD, World Almanac

Hungary is probably the most attractive Eastern European nation for Western investment. The country is relatively liberal in its dealings with the West and spends about 2.5% of its gross domestic product on research, compared with 2.8% in Japan. Technical skills are on a par with those in the West, says a spokesman for Siemens's Budapest subsidiary.

The best prospects in Hungary probably await the small and midsize company offering low-cost products through a joint venture, advises Terry Boyle, sales director of Wayne Kerr Electronics Ltd., part of the Farnell Electronics Manufacturing Group in Sussex, England.

Wayne Kerr has conducted business in Eastern Europe for the past decade, says Boyle, and now draws about 30% of its revenue from the region. The company—reportedly the only ATE company to set up shop in Eastern Europe—will sell its low-cost testers in Budapest via a joint venture with a Hungarian investor who will market the products and provide the contacts and technical support. "In the old days, [Western] companies preferred to work with distributors or agents," says Boyle. "Now the trend is to cut costs by going direct. Meanwhile, the Eastern European buyer demands technical support and advice on doing business. You can't get that from a rep."

Hungary

Land area: (sq km)	93,030
Population: (1988)	10.6 million
GDP: ($ billions, 1988)	$68.8
GDP per capita:	$6,491
Growth of GDP: (1986-88)	1.5

Source: OECD, World Almanac

A U.S. Department of Commerce source noted earlier this year that Poland plans to invest $7 billion to develop its telecom system by the year 2000, adding 7 million lines to the present network. Despite the presence of 20 or so Polish telecom producers, domestic demand far outweighs supply. Equipment that is available comes primarily through old licenses from Western companies; E-10 switches produced by Poland's Telkom-Teletra are based on a 1972 license from France's CIT.

Western companies are warned to scrutinize their marketing strategies and financial positions and those of prospective Eastern European partners. Does your company enjoy the resources to ride out the economic ups and downs that are sure to accompany democratization? "Even if your company can afford it, how will management and the shareholders accept that the necessary cash flows will be exposed to unpredictable economics and financial fluctuation or apparently irrational political and social turmoil?" asks Maurice Olivier, vice president of Arthur D. Little International in Brussels.

Poland

Land area: (sq km)	312,678
Population: (1988)	38.4 million
GDP: ($ billions, 1988)	$207.2
GDP per capita:	$5,453
Growth of GDP: (1986-88)	1.0

Source: OECD, World Almanac

For companies planning a partnership with an Eastern European company or agency (generally the least risky entry to a new market), it is essential to identify and consider issues practically unheard of in Western nations. "It is a very uncertain legal situation with respect to joint ventures," says Karl Leitenberger, deputy director of economic policies at Siemens AG in Munich. "The companies are heavily in debt and haven't revealed their balance sheets. No one even knows who owns the property there."

Romania

Land area: (sq km)	237,500
Population: (1988)	23.3 million
GDP: ($ billions, 1988)	$94.7
GDP per capita:	$4,117
Growth of GDP: (1986-88)	0.1

Source: OECD, World Almanac

Be prepared as well for a completely different style of doing business, warn most sources. While Soviet and other workers in the East are by no means lacking in intelligence, three generations of centralized planning have left millions of them lethargic, suspicious, and resistant to change. One result: Productivity rates in Western Europe are three times higher than in the East, according to Alfred Prommer of Prommer Consultants in Munich.

Yugoslavia

Land area: (sq km)	255,804
Population: (1988)	23.8 million
GDP: ($ billions, 1988)	$154
GDP per capita:	$6,471
Growth of GDP: (1986-88)	N/A

Source: OECD, World Almanac

Everyone agrees that the most important commodity of all is patience. The company out to make a quick buck in Eastern Europe is advised to look elsewhere. Says ADL's Olivier, "The payback period will be at least 5 years, and possibly up to 10 years." ☐

The color of money isn't always green

Getting capital in Europe is only part of the problem. Steering through currency fluctuations could be even trickier

BY TERI SPRACKLAND

More than fluency in languages, the ability to think in currencies other than dollars is vital to economic success in Europe. Business sense as learned in the U.S. marketplace won't enable one to acquire or manage capital in the quicksand of the European markets.

For some U.S. companies the first lesson may be how to capture venture capital in Europe. For others it may be how to manage the flow of expenses and profits in more than one currency. In either case ignorance could be fatal to profitability.

The venture-capital scene in Europe is still fluid because even the more mature venture markets are less than 10 years old. Financial markets do not support initial public offerings to the extent seen in the United States, and profit-to-earnings ratios differ considerably. Europe has yet to define a successful formula for exit strategies, so a key to successful capital hunting in Europe is to outline an exit plan—be it by IPO or by acquisition.

Even though money has fewer territorial barriers than ever before, there remain limitations to international venture-capital flow. But as markets become more internationalized and the European venture-capital market matures, venture capitalists are looking for a mechanism that will help ease the flow of money both within Europe and between Europe and the rest of the world. In the next few years, they expect intercountry differentials in cost and availability of capital to be wiped away, thus lowering some of the risks as the landscape of the European market undergoes rapid changes in virtually all industries.

Scouting the markets

The capital markets are still developing, each country has its own flavor, and expectations differ widely.

The 1989 survey of European venture capital conducted for KPMG Peat Marwick shows that about 3.48 billion European currency units—$4.77 billion—was raised in 16 European countries, up 19% from the previous year. Even Iceland and Finland are now participating. Newcomers Austria and Portugal increased venture capital raised by more than 200%. Although increases in the U.K. and France were less dramatic at 20% and 29%, respectively, the amounts raised in 1988 were substantial: $438 million in the U.K. and $199 million in France.

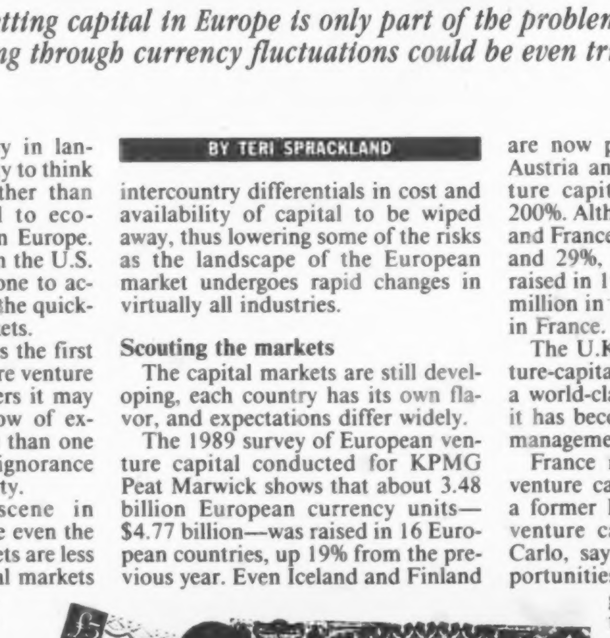
The U.K. is the leader in the venture-capital market in Europe, with a world-class financial structure, yet it has become absorbed of late with management buyouts.

France ranks second in terms of venture capital raised. Willy Conig, a former Intel executive and now a venture capitalist based in Monte Carlo, says France offers many opportunities for investment, but ingrained attitudes can sometimes create roadblocks. Although the Alpes-Maritime district near the Riviera offers high-tech businesses opportunities, it has taken years to resolve simple infrastructure problems, he says.

Italy's venture-capital business is growing rapidly, although less predictably than in Northern Europe. The entrepreneurial spirit is respected, but many deals are done through family groups, especially among smaller enterprises.

In Germany, venture capital is a relatively unknown process as funding is controlled by a conservative banking establishment. Exit strategies are difficult to implement, equity is not a strong concept, the tax environment has been unfavorable, and liquidity is limited.

The Netherlands has a maturing venture-capital industry, due to the



multitude of venture-capital firms and an awareness of international opportunities, thanks to the traditional Dutch focus on export. Its 1988 growth rate was a high 158%. Banks and pension funds remain the largest sources of funds, according to the survey. However, investment in high-technology companies declined slightly between 1987 and 1988. The average investment size in the high-tech sector was $604,170.

"In 1984, the European Roundtable of Industrialists realized we had to stimulate innovation or die of Eurosclerosis," says Albert Kloezen, managing director of Euroventures Europe, in 's-Hertogenbosch, The Netherlands. "Euroventures was the first venture, supported by 12 major industrial shareholders. Euroventures created a transnational venture-capital group. The group is still 60% industry-supported, with 40% from banks and other institutions and $3.62 million under management," he says. The group expects a 15% after-tax profit this year on its portfolio.

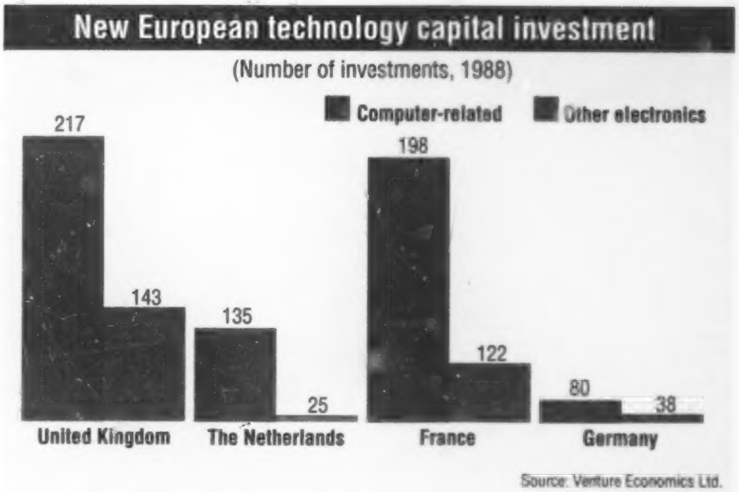
"Europe started later in venture capital, but we have learned from others' experiences. The techniques are not so different, but the original investors were more often banks and industrial companies," Kloezen says. Industrial companies gave $40 million to start Euroventures, and about 5% to 7% of the deal flow for Euroventures is coming from companies in the United States.

Kloezen, whose group recently started a Hungarian venture-capital fund, says ventures in Eastern Europe are much easier to manage from a European base than from outside Europe. "Strategic alliances for the next 10 years are being made now," Kloezen says. "We are also going into Poland and Czechoslovakia to act as a matchmaker and as an educator. We hope to teach capitalism to the new entrepreneurs of Eastern Europe."

Kloezen cautions against joint ventures, which he claims are fraught with problems when partners are unequal. "It is much better to start with an alliance to get acquainted. A successful alliance can end with a joint venture. It shouldn't start with one," Kloezen says. "People must realize that the power structures at the global level are changing. Alliances that have been valid for nearly 30 years are no longer secure."

New European technology capital investment

(Number of investments, 1988)



Source: Venture Economics Ltd.

Another problem in getting venture capital in Europe is the limited availability of seed money, he says. Cautious players avoid risk by being second-stage investors.

Maturing sectors of the European venture-capital industry are under shakeout stress, according to Nick J. M. van Ommen, managing director of a Belgium, Netherlands, and Luxembourg fund of Euroventures. Last year, participation in the Dutch venture-capital industry topped $4 billion, drawn from about 80 organizations. In addition to Euroventures, major Dutch venture-capital players are MIP, Atlas, and NORO. Many of the smaller companies are straining for the resources to meet second-round financing, says van Ommen.

Capital markets are still developing; each country has its own flavor

Still, the unification of the European market will produce economic growth of about 1% a year, equivalent to twice the growth experienced under the Marshall Plan, according to an European Community report. Europeans are increasingly willing to invest in cross-national deals, especially as opportunities in Eastern Europe and the unifying Common Market appear. Hungary tops many investors' list as the most advanced former Eastern bloc member.

Business in Europe is fundamentally more hierarchical than in the United States. The idea of selling the privately developed company to an existing company is not cloaked in an aura of failure or desperation, as it may be in the United States. European investors and industrialists are much more likely to see opportunities in amalgamation.

The currency conundrum

Funding is only part of the challenge in managing capital in Europe. Compaq Computer Corp. recently made a dramatic increase in profitability because it found itself on the upside of a currency change. But where there are windfalls there can also be pitfalls.

Although large multinational companies have been coping with currency fluctuations for years and are well-versed in the process, the small to medium-size U.S. electronics companies, or those without a lot of time on the international scene, may be unprepared. In addition, expertise in international capital management in companies may be sequestered within the CFO's office, while the implications of these decisions are strategic in scope.

In the past, European currencies would fluctuate freely against each other, pushed or swayed by the elements of national events or policies. However, as the German economy

Companies discover how to open the European money box

Although market opportunities appear to be growing faster in Europe than in the United States, it is not always easy to match U.S. companies with European investors.

Innovative approaches, though, can open up the money box.

For Sybase Products BV in The Netherlands, the answer has come from a plan proposed by its managing director, Guus Alink. Sybase was not able to offer sales support on a grand scale when it started its European operations; in fact, the software company employed only 50 people worldwide. Alink saw an opportunity for structuring a type of joint venture that factors in the difference between profit-to-earnings ratios in Europe and those in the United States.

Eurosem's Dean Strausl says finding local connections can be almost as important as finding capital

"The joint venture is established so that the U.S. company can acquire the European company at a takeover price set at 85% of the U.S. profit-to-earnings ratio times the profit made by the European venture," says Alink. Prior to the acquisition, the U.S. company gets royalties on all its products sold through the European venture. The U.S. company makes royalties until it is ready to acquire the European venture, at which time it also makes a profit. This deal attracts local management, who get to share in the company's success.

He cautions the strategy is only effective in high-tech deals because that is where the difference exists in profit-to-earnings ratios. "You need a crew of people with the right expertise to match the Americans' expectations, or there will be problems in integrating the venture once acquired," says Alink.

A royalty-based deal is particularly suited to software companies, whose income is largely derived from royalties. "The software market is dominated by the Americans, who have unquestionable leadership," Alink notes.

Managers for such ventures can be found among the second tier of local companies, Alink says. "Look for guys who don't have a stake in another company yet. They bring the resources of their relationships and can assist in the financial planning," he advises.

A venture project that stumbled and is now regaining its footing with an infusion of local money and connections is European Semiconductor Assembly (Eurasem) BV, a Netherlands-based subcontract semiconductor assembly and test facility.

Eurasem was created in 1987 by Dean Strausl, a former manager at Advanced Micro Devices Inc., to produce high-pin count surface-mount packages for international semiconductor makers. But the confusion over local content rulings expected from the EC pushed the company to the point of bankruptcy as potential U.S. clients remained indecisive, says Strausl.

Only the building of a complete fab assembly facility in Europe (at a cost of $200 million to $400 million) will allow a company to escape paying EC duties on its products, but duties can be minimized by bringing products into the EC at the wafer stage, says Strausl. He warns that fab time will soon be harder to negotiate for smaller companies looking for local foundry deals.

In 1989, Eurasem was bought out by Joep Van Den Niewenhuyzen, the managing director of the Begemann group of companies, a $1.2 billion industrial holding company from The Netherlands. Van Den Niewenhuyzen has made a striking impact on the European venture-capital scene with the acquisition of more than 80 companies and an annual sales growth rate of 100% per year for the last six years.

The addition of a local connection may be nearly as important to the survival of Eurasem as the money invested, says Strausl. Although local business groups were very supportive during the growth of Eurasem, the lack of access to informal business networks made the growth of the company more arduous. Many subtle differences, from education levels needed at different hiring levels to overtime expectations, can affect a new business, he says. ☐

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has become more pivotal within Europe, other countries have brought their currencies into a narrower trading range with the German mark. For some years, the Dutch guilder has been aligned with the mark, and even the French franc trades within a predetermined range on the basis of the French government's determination not to let its currency slide below Germany's.

In early October, after much hesitation, the British entered the pound into the European Monetary System and thus linked their currency's future to those of continental Europe. The EMS was founded in 1978 to encourage trade by reducing currency risks. For the British, it was a traumatic decision which involved not only concerns over the comparative economic strength but the political backlash of forfeiting control of the pound by the Bank of England, which is nearly as much a national symbol as Buckingham Palace. But as is true everywhere in Europe, choices deemed unthinkable last year are linking countries once separated by hundreds of years of suspicion and dozens of bloody wars.

European currencies are starting to move more in unison as the economies become more closely linked. What affects the German mark is likely to affect the lira or the French franc or the pound. The downside for Europeans is that bad economic news anywhere in Europe will spread quickly.

There is both danger and opportunity in the changing circumstances. The combined power of merging

European currencies will buffet the currency markets, whether from a cash or futures perspective. Yet currency merging seems to be happening.

The ECU, the European currency unit, is likely to become a hard currency in the coming decade. Currently, it is a composite currency unit made up of a basket of currencies from the EC. The weight of each currency in the basket can change on the basis of the income and trade of the country. Each currency is given a central parity rate against the ECU and must stay within a specified margin. However, financial transactions (even on the individual level, such as credit-card billings) will increasingly be possible in ECUs.

"One currency is realistic. Before we enter the twenty-first century, we will have one currency. With electronic funds transfers, it will be even more difficult if we don't," according to van Ommen.

Belgium has minted ECUs, but the coins are not in circulation.

For companies whose manufacturing costs are set in one currency but who sell in another, several choices exist to manage currency risk. (Exposure exists any time a company has either funds or investments in any currency other than its local currency.)

One choice is to insist that customers pay in the company's currency of origin. The drawback to this simple approach is that customers may not want to pay in dollars and may, instead, buy elsewhere. It all depends on whether the company feels itself to be in a buyers' market or a sellers' market.

Any company wishing to handle its currency exposure must first define its exposure and then adopt a hedging policy, which can be managed with either internal or external techniques. Internally, a company can minimize its exposure by billing in its currency or by adjusting its foreign-currency selling prices by what it expects to be changes in currency values. It can slow or speed up its receivables or payables. It can change the denomination of its assets and liabilities, or it can hedge only the net exposure after offsetting foreign-currency payables and receivables.

Externally, the company can take out forward contracts, buy options which give it the right but not the obligation to exchange currencies, or sell their receivables to shorten exposure.

Forward contracts can be established through banks or the over-the-counter dealing centers with specified combinations of currencies, amounts, and transaction dates.

Transactions in the forward market allow the exchange of one currency for another at an agreed-upon rate for settlement on a specific date within one year, according to G. Nanne J. Boll, value arbitrage adviser, NMB Bank, Amsterdam. Longdated forwards are those contracts settled more than a year later.

A useful procedure is to hedge foreign currency-denominated payables or receivables in the forward market, according to Boll.

Other safeguards include the hedging of potential foreign-exchange losses from translating foreign-currency financial statements into parent company currency terms. "A company that is bidding on a project may wish to hedge its exposure in case the exchange rate changes," says Boll.

The key, according to Arthur Smit, manager of treasury operations at AT&T Network Systems International BV, in Hilversum, The Netherlands, is a coherent company philosophy in managing currency risk. Evaluate where your company's costs would be increased, but also look carefully at when your competition would be vulnerable, he stresses. A company is not only at risk for costs directly related to its business but can be hurt by the increased competitive stance of a competitor with a different currency base.

Companies can buy on the spot-currency market to acquire currency in the payment denomination needed at the time of the transaction, according to Boll.

The option market developed out of the futures market and now generates as much as $10 billion in daily global transactions. Options exist for pounds, German marks, Swiss francs, yen, and Canadian dollars, written against the U.S. dollar with secondary markets in ECUs, French francs, and Dutch guilders. Options contracted are for large amounts, with most transactions at least $5 million.

Futures trading in currencies has a long history at exchanges in the United States, but currency contracts are more recent and grew as trade became more globalized. The volatility of the European futures markets can make Las Vegas look like a sure bet. No matter how confident your analysis of market direction, it is truly a bet-the-company decision to wade into the futures markets with a speculative approach.

Euroventures' Albert Kloezen: "We had to stimulate innovation or die of Eurosclerosis"

Professional futures-traders continually emphasize the need for viewing futures transactions by companies as a means of limiting risks, not speculating. Speculation is best left to those who spend their every waking second watching the gyrations of multiple markets.

Corporate investors should take the opposite position in the futures market than they hold in cash, in essence paying an insurance premium against the possibility of loss. ☐

Texas Instruments supplies Europe with homegrown chips

TI's production goals and Italy's strategy for development find a meeting ground in the town of Avezzano

BY TERI SPRACKLAND

Italy's Mezzogiorno region, southeast of Rome, is the site of a $1.2 billion industrial development effort. Not since the Romans held mock naval battles on the now-vanished lake has so much engineering been focused on the region. The key to the effort is Texas Instruments' first MOS memory fab in Europe.

The project, a 4- and 16-megabit DRAM fab with a clean room the size of a soccer field, will complete TI's strategy to put memory manufacturing in Asia, the United States, and Europe. All of TI's memory customers in Europe will be able to buy European-made chips, with the overflow available for export. The fab itself, already in pilot production, will cost more than $250 million.

Texas Instruments Europe at a glance

Fiscal year	1989		1988	
	($ millions)	(% of total)	($ millions)	(% of total)
Net revenue	$969	14.9%	$991	15.4%
Operating income	-30	-8.5%	-3	-0.6%
Identifiable assets	574	11.9%	530	12.0%
Number of employees	7,000	19.3%	7,000	19.8%

Source: Company reports

The small town of Avezzano is nearly dwarfed by the size of the construction site, but local authorities are working closely to keep the project in harmony with the town. Everything from housing to educational needs for new employees had to be considered, but Avezzano's aggressive young mayor, Eleuterio Simonelli, clearly intends to integrate the project into a local framework. Although both American- and Japanese-style grade schools have been opened for TI employees, Simonelli rejected a request to build a separate housing project and high school. He prefers to scatter newcomers throughout the neighborhoods rather than create a separate expatriate community.

The town was damaged in World War II and by an earthquake earlier in the century. Everything from new water-supply systems to electrical substations had to be built to accommodate the project. As the infrastructure is put in place, the local, regional, and national authorities hope to see it become a nucleus for further development.

Most of Italy's electronics industry has been concentrated in the north, especially around Milan. Italy has created a set of incentives to develop Mezzogiorno, and Texas Instruments is the first foreign company to make use of them. "Practically every foreign company investing in Italy has come through Avezzano. There have been five new banks opened in the last 10 months," notes plant manager Antonio Cuccurullo.

In addition to semiconductors, the agreement with the Italian government provides for the upgrade of semiconductor assembly and test operations and expansion of calculator manufacturing at Cittaducale and the expansion of electrical controls production at Aversa.

Yet even for a company important enough to get the enthusiastic support of its host country—to the tune of $700 million—the road to profitability is never smooth. The specter of excess production capacity in Europe, where Asian companies pour billions of dollars into building semiconductor plants, is looming. In addition, the economic downturn expected in the U.S. economy is likely to spill into Europe eventually. Even if European trade barriers materialize, however, pricing on commodity chips has become a worldwide market decision.

"Our strategy for semiconductors is that we want to significantly expand submicron CMOS capacity, implement that capacity early enough in the market to grow with the market, and put this capacity where we need it to support our customers around the world," says Roberto Schisano, vice president of Texas Instruments' Semiconductor Group. "Avezzano is a cornerstone of this strategy. If you look at our worldwide capacity, by 1992 we will quadruple our existing CMOS wafer-fab capability."

Like many observers, Schisano, formerly head of Italian operations, believes growing demand from an increasingly dynamic European economy will mean strong components sales throughout Europe.

At one time, TI kept its capacity concentrated. Now, service and sourcing demands have led TI to the conclusion that, as manufacturers, they can't afford long cycle times and remote locations.

"With this program we will expand and improve our European operations in three areas: semiconductors, calculators, and electrical controls," says Jim Hubbard, senior vice president of the Semiconductor Group and general manager of European operations. "National markets are disappearing. We expect to see more mergers and alliances. There is a lot of political pressure not to merge with the Japanese. The question is, who will survive?"

Many global companies have discovered that sales, distribution, and manufacturing can no longer be handled efficiently on a country-by-country basis. Some, like TI, are already moving to a pan-European structure, which is less autonomous but offers more economies of scale.

For Texas Instruments, the Avezzano project is the culmination of a 30-year evolution of a pan-European strategy intended to keep the company close to its customers. With most of Europe unifying into one market, TI expects the strategy to pay off. TI ranks among the top 150 European technology companies, with 8 manufacturing sites, 32 sales and marketing locations, 8 regional technology centers, over 7,000 employees, and $1 billion in annual sales. Almost one out of every 10 TI employees lives in Europe. TI does business in 15 European countries.

Only N.V. Philips outsold TI in integrated-circuit sales in the European market in 1988, while TI boasts the number-one spot in MOS memory and bipolar logic.

Semiconductors make up about half of TI's total trade activity in Europe. The rest comes from industrial automation and control systems, business computer systems, consumer electronics products, defense electronics, metallurgical materials, and electrical control products.

Manufacturing operations were started in Bedford, England, in 1957, making TI the first U.S. semiconductor company to build a plant in Europe. It now has manufacturing operations in Nice, France; Almelo, The Netherlands; Freising, Germany; Porto, Portugal; and several locations in Italy. Semiconductor support centers are divided into local areas of expertise, with France the center for MOS logic, automotive and telecommunications, military, and space integrated circuits. Germany is the center for digital integrated circuits, sensors, and gallium arsenide. The Italian center supports ASIC memories, and the British center supports ASIC systems, analog design, VLSI design, and computer-aided design software.

There are regional technology centers in Frankfurt, Hannover, and Stuttgart, Germany; Velizy, France;

How Italy's new incentives helped TI set up shop

European governments have been scrambling to snag key development projects by multinational companies before the Single Market opens its doors on Jan. 1, 1993.

"It is almost a bidding war out there," notes Adriaan Roosen, manager of the West Coast branch of the Netherlands Foreign Investment Agency, a branch of the Dutch government that seeks out foreign investors worldwide. Some countries provide direct cash incentives. Others maintain that productivity and location issues are at least as important to long-term success as direct grants. Holland, for example, bills itself as the gateway to Europe and notes 60% of the population speaks a second language, and about 12% speak three languages.

Last year, Texas Instruments became the first foreign multinational company in Italy to sign a *contratto programma*, or planned contract, with the Italian government for investments in the Mezzogiorno region.

The incentives have, until now, been used only by major Italian companies such as Olivetti and Fiat. Other multinationals are now expected to follow TI into the planned negotiations. The process is complex and requires constant contact with government officials, but it can pay off.

TI received $700 million in direct grants, about 57% of the total cost of the project. "That is more than the Italian government has ever invested in SGS-Thomson," notes Carlo Longoni, SGS-Thomson Microelectronics' corporate VP of headquarters and European regions.

There were several keys to TI's success:

- Defining specific research, development, and training elements;
- The government's intent to grant incentives;
- TI's description as a "large industrial group" to meet specifications;
- The public-works projects, costing about $13.9 million, that were covered by the government;
- Formation of a research consortium involving TI and the University of L'Aquila.

In the case of Texas Instruments, the planned negotiation was approved by the Italian Interministerial Committee for Industrial Planning (CIPI). A preliminary proposal was prepared by TI with the help of local consultants specializing in technical, fiscal, financial, and legal expertise on the Mezzogiorno. By March 1989, TI presented the preliminary proposal.

The final proposal, a much more complex version, was finished in about three months and describes the company, its business and economic effect on the Italian economy, and its products, production cycles, and investment plans.

Legal preparation of the contract was done by TI and the Mezzogiorno Ministry, with careful consultation, revision, and approval every step of the way. The process was at one point delayed by the fall of the Italian government, but in October 1989, the project was reviewed by the Budget Ministry and sent to CIPI for final approval.

In total, the state committed over 964 billion lire, about $686 million at the time. $307 million was for the new plant in Avezzano, $12 million was for the expansion of the plant in Cittaducale, and $9.9 million was for expansion of the plant in Aversa, for a total of 44% of costs. The research center in Avezzano received $39 million in direct state investment, and the research center in Aversa received about $774,000, 74% of costs. Five research projects were funded at $293 million—about 80% of R&D costs—while training projects received $22 million, or about 90% of training costs.

BY TERI SPRACKLAND

Amsterdam, The Netherlands; Milan, Italy; and Stockholm, Sweden.

Satellite connections through TI's worldwide telecommunications systems allow rea[illegible]acking for customers' produ[illegible] information requirements. Th[illegible] design centers in Bedford, Nice, Freising, and Rieti, Italy, are linked by satellite to other TI centers around the world.

Texas Instruments' Italia SpA ranks as one of the 150 largest companies in Italy and in the top 15 in electronics. Its involvement dates back to 1958, with the production of components for household appliances at a plant in Aversa. Eventually, a subsidiary was formed in 1985, headquartered in Cittaducale. The subsidiary's sales grew 20% last year to more than $320 million. The expansion of TI's operations in Italy adds about 1,000 new jobs to the existing 2,000 in Italy.

TI's plans for Europe extend beyond Italy. "If the European Community and 1992 is a political vision, the economic realities are bringing it about. The real driver is the strength of the economic needs," concludes Schisano. "Even if you consider Europe as one area administratively, it is certainly not one country. It has taken us 20 years [illegible] up with Europe and develop our European strategy. And that means much more than just having a foothold in one place in Europe." ☐

Avezzano is a cornerstone of TI's global strategy, says VP Roberto Schisano

A lucky twist of fate for Burr-Brown Corp.

With 31% of total sales, the company's European units couldn't have worked out better if they had been planned

BY H. GARRETT DeYOUNG

Ask most U.S. companies to recall how they kicked off their overseas operations and you are apt to get a dissertation about expansion strategies, long-range market analysis, and lofty plans for "going global."

But not at Burr-Brown Corp. "It was pure serendipity," shrugs James J. Burns, president and CEO of the Tucson, Ariz.-based analog-circuit design company. "Our rep in the United Kingdom went bankrupt back in 1971, and rather than hire another, we set up our own operation. It turned out to be a good decision."

Pretty goo[illegible] Burr-Brown's U.K. subsid[illegible] so successful that it soon [illegible] fully owned subsidiaries in France, Germany, Sweden, Austria, Belgium, and several other countries. In some cases, says Burns, market revenue tripled during the first year. European sales now account for about 31% of Burr-Brown's total annual revenue of $112 million; the rest is divided about equally between Japan and the United States.

Each of the company's European units are to some extent unique, of course, since no two markets are exactly alike. But all share a few basic operating principles—knowing the customer's needs and idiosyncrasies, for example—and tying into local resources, which are on view at Burr-Brown's European headquarters in Filderstadt, Germany, near Stuttgart, in the heart of Germany's high-tech belt. Primary targets for the unit include the high-end sectors of the German medical-instrumentation and numerical-control markets. Sales this year will total about $31 million and grow by some 25% a year, beams Tilman W. Kiess, the supercharged extrovert who directs the company's European operations. "Some of our competitors rely mostly on good marketing," says Kiess. "Our strategy is to move quickly into new applications then follow up with technical support."

One of Burr-Brown's first decisions was to hire Europeans to run the new sites rather than send over U.S. managers. The reason, says Burns: While most Europeans are fluent in English, many are more comfortable conducting business with fellow nationals in their own language. It is too easy for even the most skilled American manager to miss a subtle but vital point because of obscure cultural or linguistic barriers.

As it was with the original decision to set up shop in Europe, little analysis went into picking Filderstadt as the company's German headquarters. The most important factor in making the decision was to have Kiess run the new unit, and Kiess just happened to live in the area. "But Stuttgart also is at the very center of things in Germany, and there is an excellent foundry service in the

Burr-Brown Europe at a glance

Fiscal year	1989 ($ millions)	1989 (% of total)	1988 ($ millions)	1988 (% of total)
Net revenue	$51	30.6%	$48	27.1%
Operating income	2.9	33.3%	1.4	12.1%
Identifiable assets	25.6	15.9%	20.8	15.6%
Number of employees	275	17.8%	270	18.3%

Source: Company reports

Tilman W. Kiess: "Our strategy is to move into new applications then follow up with technical support"

area," explains Burns. "So it was a fortuitous decision."

That was about 15 years ago. Since then, Burr-Brown has learned a thing or two about doing business in Europe. Perhaps most important is the recognition that Europe is and probably always will be a crazy-quilt of quirks and irreconcilable differences. Warns one German electronics CEO: "The biggest mistake U.S. companies make is to set up an office somewhere in the United Kingdom and say, 'Now I can sell in Europe.'"

In France, for example, business tends to depend largely on personal relationships between the vendor and the buyer, explains Kiess. Italian and British buyers are similarly undemanding but can be fickle, changing specs—or suppliers—with little notice. On the other hand, Swiss and German buyers are obsessed with product performance and overall quality. "They will drive a product 125% or 150% beyond the specifications," says Kiess. "That puts a lot of emphasis on service and support."

Equally important are the regional differences that abound in larger nations, such as Germany. Kiess complains that the Filderstadt team comes up with "more good [analog-design] ideas than we can execute—we just can't find enough good analog people." But unlike Americans, skilled German workers are reluctant to relocate from one area to another—especially between the scenic, laid-back Swabian region in the south and the hard-driving industrial north.

Finances pose another key distinction between European nations. Since Germany lacks a mature venture-capital industry, for example, the nation's powerful banks play a much larger business role than in many other countries. (Most Germans still prefer cash to credit, so the average citizen becomes a fixture at the local bank by maintaining several bank accounts throughout his or lifetime, starting early in life.) Burr-Brown thus kicked off its European expansion by setting up banking relationships all over Europe. Result: an unsecured line of credit guaranteed by the parent company in Tucson.

Part of Burr-Brown's success in Filderstadt is also due to good old-fashioned networking. While most U.S. companies find Germany a relatively unintimidating starting point—there are few legal or governmental constraints—Kiess stresses the need to link up early with other companies. Given its emphasis on medical, industrial, and high-definition TV markets, for instance, Burr-Brown teams up frequently with Siemens AG, which accounts for about 30% of the unit's revenue. "A new company needs contacts to describe the local rules," says Kiess. "Buyers here aren't impressed by shiny catalogs or big trade shows but by solid data that is presented well."

Burns concedes his share of mistakes along the way, including the failure to centralize the company's inventory and applications-engineering functions at the outset. Otherwise, he claims, he would do it over again in an instant. "Sure we were scared at first," he admits. "You never know how successful you are going to be or how much it will cost. My advice is that once you have made the decision, trust your instincts and just do it. . . ." ☐

Sun Microsystems aims for first place in Europe

The company has been in Europe since 1984, but leadership remains elusive. That's the challenge for the workstation maker

BY BARBARA N. BERKMAN

Every week, Scott McNealy throws away a handful of letters from marketing gurus trying to sell him information on how to cope in the European Single Market of 1992. "I'm still not sure what 1992 means," says McNealy, CEO of Sun Microsystems Inc. in Mountain View, Calif.

McNealy isn't the only one who is confused about 1992. But Sun has never let itself get bogged down in abstractions about the New Europe. "You just use logic and common sense," McNealy says.

Sun has spent the past six years using common sense and logic to build its European operations. The company's first move was to England, where it set up a sales and distribution center. Today, Britain contributes about 30% of Sun's European revenue. All told, Sun has eight European direct-sales units and plans to add two more during 1991. European sales are approximately $700 million, about one-third of the company's total revenue.

When they first started out, McNealy and Sun's other young founders knew nothing about the European market. But they did recognize Europe's importance as one of three strategic markets in its global strategy—the other two being North America and the Far East. That strategy called for becoming the biggest workstation vendor in the world.

Over the years, though, Sun's strategy in Europe has changed. In the early days while impetuously grabbing market share, Sun ran itself with an unstructured style dictated by the sizzling pace of its growth. But the days of easy growth are over. Sun's real test of success in Europe will come in the next few years.

The question now facing McNealy is this: Can Sun outrun the competition to win market domination in Europe? To do so, it will have to battle market heavyweights such as Digital Equipment Corp., Hewlett-Packard Co., and IBM. Sun is giving itself 18 months to become the dominant European workstation vendor. That means becoming the clear market leader in Spain, Switzerland, Austria, and Germany.

"Relatively speaking, we aren't doing as good a job in Europe [as the competition]," admits McNealy. "We still have incremental investments to make in research and development, manufacturing, sales and service, and marketing." He labels Sun's challenge as "growing faster and investing more."

McNealy thinks Sun can climb to the top of the European workstation market. He plans to win market share in three ways:

- By saturating the European market with improved customer service;
- By selling workstations manufactured and serviced locally;
- And by designing products at its networking research center in Grenoble, France.

The critical issue for Sun in Europe is funding for growth. So far, the money has been forthcoming. While Sun's overall profits slid in 1989, Sun's European operations were thriving. Earlier, during the mid-1980s electronics recession in the United States, Sun didn't extend its hiring freeze to Europe, where the market was solid. "The balanced, mature answer may have been to slow down globally. But McNealy was willing to take risks," says Darryl Barbe, vice president of European operations. A resident of Europe for almost two decades now, Barbe was hired from DEC to start up Sun's European operations.

Sun avoided skimping on its European budget until it reported a $20.3 million overall loss in the fourth quarter of fiscal 1989. Then, Sun's management prudently delayed construction of a manufacturing plant in Scotland during those lean times.

The purse strings are being pulled even tighter now as the U.S. and European economies slow. Sun in Europe runs under McNealy's global edicts. When he circulated a memo in October that froze all non-essential expenses, Sun Europe also had to take a hatchet to intercontinental travel and discretionary hiring.

McNealy's goal is for Europe to contribute one-third of Sun's global revenue within five years

Sun executives claim that European market dominance will come only if Sun sticks to its global game plan. "We knew if we didn't get started in Europe right away, the company probably was not going to succeed. That was all the vision we needed to get started in Europe," recalls Barbe.

Sun Europe grew by leaps and bounds in those early heady days. During the six months from the time the company set up operations in Europe to the end of its second fiscal year, Sun grew from $9 million to $39 million in sales.

"It has always amazed me how Sun was able to operate with no real infrastructure in place at the beginning," recalls Richard Barker, vice president of European finance. "The sheer madness of getting started meant you could be dealing with petty cash in the morning, and in the afternoon you were negotiating a multimillion-dollar deal and setting the prices that would govern the company for the next several months."

For the first two years, the company stretched its European infrastructure. Unlike Sun's MIS system in the United States, which ran on a Hewlett-Packard model 3000 minicomputer, Sun's European MIS system functioned on PCs. "There was a dramatic undersizing of our business. We were playing catch-up in Europe," Barbe admits.

The experience left Barbe with one piece of advice for fast-growth companies. "If you are planning to grow like we did at Sun, overhire at every key job. It gives you a much lower turnover rate." In Europe only one key manager has left the operation, while the parent company has watched its attrition rate creep as high as 11.5%.

Sun's early strategy was to sell direct only in Britain, France, and West Germany under the guidance of native country managers. Barbe asked them to produce plans detailing how much revenue their markets would generate and how many salespeople were necessary to make that target. Sun's European financial director then stepped in to determine if Sun could afford the investment. Unlike many companies [illegible] starting in Europe, Sun was lucky; its quick growth justified an aggressive investment posture.

During Sun's first year of operating in Europe, Barbe set up a distribution network in Italy, Sweden, The Netherlands, and

Sun's Scott McNealy (center) beams with pride at the recent opening of the new Sun Linithgow, Scotland, manufacturing plant. With him are (left), Ian Bell, VP of Linithgow operations and Kevin Milla, VP of worldwide operations

Sun Europe at a glance

Fiscal year	1990 ($ millions)	(% of total)	1988 ($ millions)	(% of total)
Net revenue	$427.5	24.2%	$241.9	23.0%
Operating income	14.9	16.9%	-1.3	-1.2%
Identifiable assets	207.6	16.4%	181.8	24.0%
Number of employees	1,430	14%	946	13.3%

Source: Company reports

Switzerland and later expanded the network to include Denmark, Norway, Portugal, Israel, Turkey, and Iceland. Sun Europe also is responsible for sales to the Middle East and Africa.

European distributors were tricky to manage, according to vice president of worldwide field operations Carol Bartz, because they knew that in time Sun would replace them by going direct. Tension in managing the distributors eventually eased, according to Bartz, when many distributors went on to become value-added resellers and OEMs for Sun.

Some 700 VARs now peddle Sun's workstations in Europe. Within six months the company will decide on a strategy for alternatives to VARs, such as a dealer channel. "It is a lot different in Europe than in the United States, because there is no one dealer [in Europe]," says Barbe.

Sun's strategy is to reach corporate decision makers—buyers who "don't go down to Businessland," according to McNealy.

Key to Sun's international plans are alliances with local OEMs and VARs. The first European agreement was with Oce-van der Grinten NV, a Dutch maker of high-quality copiers. "It never took off into McNealy's high-volume dream. Oce was expecting to build this into dramatic numbers," says Barbe.

But he shrugs off the failed expectations, arguing no company can accurately and consistently predict upfront the success of a venture. "You need to go after a multiple number of opportunities. You go after as large a number as you can. One or two or three won't succeed."

Sun also has relationships with Matra SA, Telefon AB, L.M. Ericsson, International Computers Ltd., and the Nokia Group. Berthold AG, a German printing company, packages some 5,000 Sun units into its publishing systems each year. Both NV Philips and Siemens AG are low-volume buyers of Sun's technology for use in their medical imaging systems.

Philips and Matra are licensees of SPARC, Sun's RISC architecture, in part because of Sun's drive to make SPARC an industry standard. Sun also wants to establish a European source for silicon to appease European customers concerned about single sourcing.

Sun looked for maximum mileage from the relationships it struck with European OEMs. Sun sold its workstations in Scandinavia through such distributors, OEMs, and end users as Ericsson and Nokia so that Sun could delay the costs of adding a direct-sales presence there until 1988.

Also in 1988 Sun management decided to build the company's first manufacturing plant outside the United States, in Linlithgow, Scotland. Compaq Computer Corp., in comparison, was a four-year-old company when it announced that it would build a Scottish plant in November 1986.

Sun wants a leading position in Europe for workstations within 18 months

Sun took a risk by setting up its first manufacturing plant outside the United States. As a result, it must train a workforce in its manufacturing techniques, educate local suppliers, and work out the logistics of distribution in a foreign country.

The company shunned the cheap route to manufacturing in Europe by moving into an existing facility. It built a new facility, but unlike Compaq and Conner Peripherals Inc., who received incentives from the Scottish Development Agency for locating in targeted development areas, Sun chose a site that wasn't slated for financial assistance.

"Sun believed the site and the plant were a marketing tool, a statement of self-esteem and image," says Robert Crawford, North American director of the SDA. "I don't think there was a site in Scotland they didn't look at."

Top company executives eliminated a continental Europe site early in the process. At the time, 27% of European sales were in Britain, with only 23% in France and 18% in Germany.

With Scotland chosen, the SDA assisted Sun in site selection and development. Crawford estimates that the agency spent $180,000 on videotaping undeveloped sites, helicopter viewings of sites, architectural guidance, airfare, labor, and assistance by local Scottish governments. That figure does not include Sun's actual financial-aid package, which Crawford describes as "a very good deal." The plant cost about $18 million to build and was capitalized at some $30.6 million to fill out, according to Ian Bell, plant manager.

Shipments from the 140,000-square-foot manufacturing floor started in June. By April 1991, Sun expects its capacity will hit 288 workstations a day. The plant can produce the SPARCstation 1+ and the SPARCstation IPC. Unlike Sun's Milpitas, Calif., plant, the Linlithgow factory is set up so that a unit takes about 15 minutes to assemble. One worker assembles the computer and then runs it through initial testing to encourage ownership and accountability for the work.

The Scottish plant will follow U.S. policy and subcontract its assemblies. Britain's ICL, with which Sun has a marketing agreement in the United States, won a contract—worth more than $36 million—to be Sun's sole source for printed circuit boards for the Linlithgow plant. "We would like to find indigenous suppliers and work with them," says Kevin Melia, vice president for worldwide manufacturing operations.

But finding suppliers and training a new workforce may prove difficult. "They will have to train a whole workforce in the Sun way of manufacturing," observes Stratton Sclavos, an American who is acting general manager of Mips Computer Systems Ltd. in Marlow, England. "I would wager they will have trouble ramping it up as quickly as they think they can."

Indeed, the frenetic pace of Sun seems odd in Scotland. McNealy feels the clash. "It is a big, big surprise to be opening a plant in Scotland, talking of the history of something eight years old in the shadow of castles a thousand years old." To address culture gaps a blue-jean clad McNealy appears in employee videos. He claims the videos effectively communicate Sun's message and "its loose, informal style." The 150 Linlithgow employees, McNealy asserts, "are so Sun it is scary."

To address the need for local product development, Sun officially opened its first European research and development facility in France in September. Located in Grenoble, the International Center for Network Computing will focus its efforts on developing high-performance Open Systems Interconnection products, OSI network-management facilities, and programmer aids for international computing. Sun will export software designed there directly to its customers around the world.

"The French are pioneers in networking and communications and will soon lead the world in software production and research in those areas," predicts Eric Schmidt, who oversees new-product development as vice president of Sun's General Systems Group. Sun chose Grenoble, he explains, because of the OSI talent located there. The University of Grenoble, for example, has a strong tradition in network research and close ties to industry.

Sun took a risk by setting up its first manufacturing plant outside the United States

Sun recruited Jean-Pierre Baudouin, a network research veteran from Hewlett-Packard, to head up the new center. By 1991 Baudouin plans to add some 25 additional European software engineers to the existing staff of 10. The Grenoble center is starting small, but Sun is not limiting its growth. "Our R&D center in Boston opened five years ago with one person. Today more than 200 software engineers work there," says Schmidt.

The Grenoble center's growth will depend entirely on how successful Sun is in recruiting qualified people. "Experienced network specialists are the most difficult people in the world to find," admits Schmidt.

Even with the combination of local R&D in Grenoble, local manufacturing in Scotland, and better customer service, it remains to be seen whether McNealy's plans for domination in Europe will work. If they don't then McNealy has an easy out: The local strategy in Europe, says McNealy, can't be separated from Sun's global strategy. "I don't want Europe to be stand-alone. I want the globe to be stand-alone." ☐

Jean Magarl in Paris contributed to this report

A clash of cultures at Tylan General

Offshore acquisitions bring new markets, higher sales —and sometimes people who just don't see eye-to-eye

BY H. GARRETT DeYOUNG

Most experts will tell you that an offshore acquisition is one of the most painless ways for a U.S. company to break into the European market. But David Ferran, president and CEO of Tylan General Inc. in San Diego, warns not to believe it for a minute, not unless you are convinced that both companies share the same vision of the future. It is also important, he adds, to anticipate the dozens of sometimes seemingly insignificant differences that will occur in how day-to-day business is conducted between the newly structured organization and the parent company.

Tylan General is a good example of what can happen when U.S. executives ignore those differences. It has been just about a year now since San Diego's Vacuum General Inc., a producer of pressure-control devices for semiconductor equipment manufacturers, acquired Tylan Corp., then a 30-year-old manufacturer of mass gas-flow systems in Torrance, Calif. The $22 million purchase was financed through a combination of venture capital and bank financing. The acquisition gave Vacuum General not only a new name—Tylan General Inc.—but also a foot in the European semiconductor-equipment market, thanks to Tylan's subsidiaries in Germany, France, and the United Kingdom.

So what is the problem? Put simply, the problem is people. More specifically, it is the suspicion, resentment, and just plain fear that arises when two or more business philosophies clash in the context of a corporate marriage. "We underestimated the cultural and communications problems that came with the acquisition," says Ferran. "It has been very frustrating. There needs to be a lot of mutual trust and respect if each country manager is to do his or her best job." While Ferran doesn't say so explicitly, one senses that those qualities are in short supply right now on both sides of the Atlantic.

If unresolved, the tensions of the past year threaten to torpedo the parent company's otherwise sound European game plan. Some of the problems are on view at Tylan General GmbH. Located in Eching, Germany—a cozy little town about 20 miles north of Munich—the unit's 24 employees account for roughly $5.5 million a year in revenue, or about 16% of the parent company's total sales. The site serves the semiconductor industries in Scandinavia, Austria, Switzerland, and The Netherlands, explains managing director Kurt Henche, and it is developing new applications in biology, food processing, and medical technology.

Tylan General Europe at a glance

Fiscal year	1989 ($ millions)	1989 (% of total)	1988 ($ millions)	1988 (% of total)
Net revenue	$12.3	33.3%	$12.2	49.2%
Operating income	1.1	34.3%	0.9	23.0%
Identifiable assets	6.6	28.5%	6.0	47.6%
Number of employees	54	20.5%	42	16.8%

Source: Company reports

Located in the heart of Bavaria's high-tech corridor, the Eching unit seems well-positioned to reap the benefits of Germany's electronics sector—without a doubt the healthiest, most lucrative in all of Europe. One advantage to doing business in Germany—especially the southern part of Germany—according to Henche, is that German customers demand high quality, good technical support, and reliable delivery, and they are more than happy to pay extra for those services. "The cheapest bid doesn't always get the order," says Henche. Another plus is the proximity to Germany's expertise in automation—the result, according to Henche, of the country's need to deal with the influx of unskilled workers who remained after World War II.

Unemployment runs only about 4% in the Munich area (versus 6% to 7% nationwide), and Henche bubbles over about the local work environment: excellent infrastructure, relatively low inflation rate, and a superb workforce. As for the nation's high wages, Henche shrugs and says, "You can hire people somewhere else for much less." But because of Germany's high productivity rate—among the highest in Europe—"you may need twice as many of them," he says.

The area's business climate is remarkably stable, in part because of the nation's tough worker-protection laws. Since it is difficult to fire people, says Henche, it is also difficult to make room for new people, unless the company is growing rapidly enough to justify creating new positions. The Germans also exhibit a strong preference for long-term relationships, "But the result is that you are working with the same [customers] for years," he says. "If you screw someone, they remember."

The main struggle, according to Ferran, is that Tylan's three European subsidiaries have been run more or less autonomously (not especially surprising, perhaps, in view of the technical and marketing differences between the various markets). One unit concentrated mostly on profits, another on customer service, and the third on new technology. "It was very entrepreneurial," says Ferran. "Each operation was basically a clone of the guy who was running it."

What San Diego's top management wants—and have yet to achieve—is more aggressive sales, higher profits across the board, and decentralized execution of Tylan General's centralized planning. "Sometimes we talk with the manager and think that they have bought in," says Ferran. "Then we learn later that it isn't happening. Maybe it is poor communication, or maybe they don't want to understand."

The main dilemma is that Tylan's three European subsidiaries had been run more or less autonomously

The situation is complicated even further by the fact that Tylan Corp. had been courted by many companies before the acquisition. "The European managers were very stressed, and some of that stress was passed along to the employees," recalls Ferran. Nor was the stress relieved after the acquisition, when the entire top management in San Diego was replaced, he says. "The European managers were wondering what the crazy Americans were going to do next."

Henche agrees with Ferran's assessment of the communications gap. "It takes time for the two cultures to get to know each other," he says. But he also notes that many of the problems are due to management's misunderstanding of how cultural and national differences can show up on the bottom line. While the U.S. parent company deals mostly with large OEMs, for example, the German subsidiary focuses primarily on end users and is accustomed to dealing with smaller profit margins than in the United States. And like most European companies, he adds, Tylan GmbH offers its employees a potpourri of benefits and considerations—such as generously subsidized cafeterias, sporting activities, and liberal vacation policies—that most U.S. companies might find excessive. "It is hard to fire people here, so you have to work very hard to keep them motivated," according to Henche.

Ferran is now determined to "clean up some of the mess," as he puts it, by working to establish trust with the Europeans while still pursuing Vacuum General's goals of growth, profitability, and debt retirement. Meanwhile, with the benefit of hindsight, he concedes that many of the problems could have been avoided by concentrating more on people and perhaps a bit less on profits. "I wish I had spent more time with the operating managers and their families," Ferran says, almost wistfully. "At least we would have gotten to know each other better, and it probably would have saved everyone a lot of time and money." ☐

In Germany, "You work with the same customers for years," says Kurt Henche of Tylan General GmbH. "If you screw someone, they remember"

Finding the right distributor

There are plenty of mistakes that can be made in Europe. Here is a guide to distribution dos and don'ts

BY BARBARA N. BERKMAN

Last March, Rich Maxwell arrived in Paris to set up a European distribution network for Stallion Technologies Inc., an Australian maker of add-on cards for Unix-based personal computers. The problem, he says, was that Stallion's existing distributors "had not been managed very well from Australia."

But since then, Stallion's fortunes haven't improved much. "Germany is a problem for us because we are late to the market. The distributors are already filled with competitors' lines, and it is difficult to get them to change," reports Maxwell. The situation in Italy isn't much better, he says. "I have been talking to one company for over a year. It is very frustrating."

Stallion is not alone. Small companies that have plunged into Europe without the financial muscle to establish direct-sales offices find setting up a distribution network hard work. The distributor's location, size, and ability to handle technical products can spell distribution success or failure. In addition to that, "Europe is a long way away, and you are doing business in different languages," says Gary Kibblewhite of Europartner Consultants in London.

But by following the advice of those familiar with the European market, U.S. companies can avoid many common pitfalls.

Unlike a U.S. distributor, a distributor in Europe is a local company that stocks the product and handles design-in, marketing, advertising, trade shows, after-sales support, customer service, and order taking. They serve small markets, which makes them self-supporting and better equipped for technical support. The most common partner for a small to midsize U.S. manufacturer is a distributor who imports as well. "That implies familiarity with the physical passing of goods through customs and with international methods of payment and currency fluctuation," notes Charlie Thayer of European Marketing in Chevenoz, France.

An agent is basically the equivalent of a sales representative and is the unique source of product for all of Europe. The agent has a network of distributors and serves the OEMs directly.

A European representative is an organization that works only with distributors and agents and has no direct customers. The rep works on a commission basis and arranges contracts directly with the manufacturer.

U.S. companies traditionally lower export costs by shipping to their own facility in Europe or by appointing an agent to distribute the shipment. That can shave about 25% off the cost of transporting products to individual distributors.

Satellite distribution hubs have their drawbacks, as Osicom Technologies (U.K.) Ltd. discovered when its French hub failed. "We didn't have enough local expertise. A strong local distributor works much better," advises Michael Connolly, marketing manager of the Cardiff, Wales, subsidiary of the U.S. computer-systems maker.

An alternative to distributors and agents is a company that arranges for the physical movement of goods from manufacturer to customer. Among them is Van Ommeren-Intexo of The Netherlands, which specializes in electronics for companies such as disk-drive maker Quantum Corp. The company invoices customers on the manufacturer's stationery, uses EDI, and provides office space for the manufacturer and a multilingual staff to take sales orders.

Such companies are an intermediate step to testing European waters, which can be pretty choppy. Some distributors, for example, will accept your product line just to keep it off the market. "It is a delay tactic. They know a U.S. company will give them at least a year in Europe because the design-in cycle is so long," warns

Comparing European distributors

Averages for each country's electronics distribution industry (1989)

	U.K.	France	Germany	Italy	U.S.
Expenses (as % of sales)	20	22	19	8	17
Salaries (as % of total costs)	45	70	60	[illegible]	60
Sales per employee ($ thousands)	270	275	300	360	350
Receivables (days)	70	110	30	140	50
Vacation days per employee	27	25	30	31	10-15

Source: Europartner Consultants

What to ask a distributor

1. Do you sell a complementary product line with the same applications?

2. Do you have at least 10 employees?

3. Do you have good bank and trade references?

4. Does the U.S. commercial office have information on you?

5. What do the country's customers think are the most important features and benefits of your products?

David Sherwood, managing director of Applied Materials & Technology, a European marketing and management service in Bristol, England.

A U.S. company will send someone over to Europe to visit key OEMs only to return to Europe three months later to find their lead is eaten away by a local. "Americans will do a whistle-stop tour of Europe with a suitcase full of faxes they have received from European distributors, and they will interview them in the hotel lobby," says AMT's Sherwood. "They could have had the same conversation on the telephone."

Instead you should be looking at their financial resources, making sure they have the technical experience, visiting their customers, and looking to see if the product manager's role is well-defined, because the product manager is the one that sells the product to the sales force.

Some experts say an even better plan is to hire a local or an American with European experience to do the job. "If they are really serious about setting up in Europe, my advice is to send someone over from the States who is experienced in European marketing and who can appreciate the customs here. It is very, very difficult to find those people, which is why companies use consultants who know Europe but don't know your product," says Fred Henley, managing director of Transtel Communications Ltd., the European sales and support arm of holding company J. W. P. Inc. in New York.

To be sure, many smaller U.S. companies are scurrying to Europe themselves to attempt to wed their products with the perfect distributor. But they soon realize that the ideal mate isn't easy to find.

U.S. companies must understand that regional and national differences exist among European distributors. In Italy, for example, receivables run to 140 days, compared with 30 days in Germany. And Italian chip customers—unlike the British customer—tend to shop around.

Some experts argue the need for two regional distributors, particularly in the north and south of Italy and Germany. Others say regional distribution is gradually disappearing.

"Business in Italy is much too concentrated to warrant a north-south divide," according to Silvio Baronchelli, chairman of Italy's National Association of Electronic Distribution. He estimates that the area south of Rome accounts for less than 10% of the total market; that the Milan region accounts for 40%; and that the corridor of Turin, Venice, and Bologna accounts for another 35%.

U.S. companies also can choose among the pan-European networks cropping up all over Europe. Many of the major suppliers prefer to be with pan-European distributors, particularly when their reason for handing the business over to distributors is to cut their cost of sales, points out Gary Ranallo, managing director of Arrow Electronics (UK) Ltd.

Smaller distributors lack financial and technical muscle necessary to market electronics products in Europe

Opponents of pan-European sourcing say fluctuations in exchange rates make it too risky. "Don't allow yourself to be dragged into cross-border franchises. You have got to look at each franchise as a separate company," advises Sherwood.

U.S. companies also underestimate the amount of support European distributors need—especially since European customers won't wait patiently until the start of the U.S. business day for the answer to a question.

Europe's large distributors have good technical support capability but often won't bother with new products that take a long time to design in. "You have so many start-ups that come here. Their products are so new, people are not eager to talk to them," says Giorgio Ghezzi, president of Italy's largest chip distributor, Silverstar SpA.

But smaller distributors often lack the financial and technical muscle necessary to market highly technical U.S. electronics products in Europe. Mips Computer Systems Inc. has worked hard to educate the European market about Unix products, explains Stratton Sclavos, acting general manager for Europe. "There are not a lot of good distribution channels for Unix and larger systems."

The problem is a common one. Iomega Corp. is the European subsidiary of the U.S. maker of a removable, crashless disk-storage device. "Our product is not a commodity product. In penetrating European markets it is a continual exercise to educate the customer, dedicated dealers, and our distributors," says Mason Herzog, director of European sales of Iomega's European subsidiary in Brussels.

Daniel Roberts was stymied when he tried to find distributors in France and Germany for the $130,000 laser-printer subsystems manufactured by Advanced Technologies Inc. of Milpitas, Calif. There were a number of small aggressive companies in Germany but none that could handle that complex a product. "We instead went to marketing agents, and we will support them directly," says Roberts, president of Opportunity Europe Ltd. in London. France, too, was a problem. "The smaller companies don't have the technical caliber to support those products."

If things do go sour, remember that an agent is almost impossible to fire in certain European countries unless the employer assumes responsibility for severance pay and about one year's lost commissions. European courts usually side with the employee. One American manufacturer protected himself by negotiating—with a handshake—a trial period before a contract was signed. □

To learn more about the New Europe

ELECTRONIC BUSINESS's guide to resources for doing business abroad

BY ELAINE M. CUMMINGS

Ready or not, the global economy is here. And although it may be several years before we see a truly integrated Europe, analysts say now is the time for U.S. companies to stake out their positions.

Once you've made the decision to expand your business overseas, the next obvious question is where? Should you think about exporting, distributing, or franchising? Should you consider a joint venture or go it alone? How do you stay informed on new regulations or standards that may affect products, markets, and your ability to compete?

Many agencies, networks, and books can help answer these and other questions. Here is ELECTRONIC BUSINESS's road map to some of the best resources we found for companies who are looking to move into the New Europe.

GOVERNMENT AGENCIES

The best place to start is with the government. Local, federal, and foreign agencies have many branches set up to address particular needs, and many offer a variety of free services.

U.S. Department of Commerce
International Trade Administration
14th St. and Constitution Ave. N.W.
Washington, DC 20230
(202) 377-2000

U.S. and Foreign Commercial Service (US&FCS) for companies building export businesses
(202) 783-3238

The Single Internal Market Information Service for info on directives, amendments, and updates and a quarterly newsletter
(202) 377-5276

Eastern Europe Business Info Center
(202) 377-2645

Office for Information Technology, Instrumentation, and Electronics
(202) 377-4466

Exporter Counseling Division
(202) 377-4811

National Institute of Standards and Technology for foreign and international voluntary standards, government regulations, rules of certification, and General Agreement on Tariffs and Trade (GATT)
(301) 975-4038

GATT hotline (301) 975-4041

◆

European country desk officers, the ITA's International Economic Policy unit, are excellent sources of information on trade potential in specific countries.

Belgium/Lux: (202) 377-5401
Britain: (202) 377-3748
Denmark: (202) 377-3254
France: (202) 377-8008
Germany: (202) 377-2434
Greece: (202) 377-3945
Ireland: (202) 377-2177
Italy: (202) 377-2177
Netherlands: (202) 377-5401
Portugal: (202) 377-3945
Spain: (202) 377-4508
Sweden: (202) 377-4414
Western Europe: (202) 377-5341
Eastern Europe: (202) 377-2645
EC: (202) 377-5276

◆

Department of Commerce industry specialists:

Electronic Legislation:
(202) 377-0507

Electronic Components:
(202) 377-8411

Electronic Components:
Production and Test Equipment: (202) 377-5014

Electronic Database Services: (202) 377-5820

◆

U.S. Int'l. Trade Commission
Washington, DC 20436
for issues related to trade administration, trade programs, and export policies
(202) 252-1807

continued

Delegation of the EC
2100 M St. N.W., 7th Floor
Washington, DC 20037
Contact: Ella Krucoff
(202) 862-9500

U.S. Dept. of State/Europe Regional
Political & Economic Affairs
Washington, DC 20520
Contact: Michael Brownrigg
(202) 647-2395

◆

U.S. Embassies in European countries are also a valuable source:

Belgium: 27 Boulevard du Regent
B-1000 Brussels
or APO NY 09667-1000
(32) 2-513 38 30
Britain: 24/31 Grosvenor Square
W1A 1AE London
or Box 40 FPO NY 09509
(44) 71-499 9000
Denmark: Dag Hammarskjold
Alle 24
2100 Copenhagen or APO NY 09170
(45) 1-42 31 44
France: 2, avenue Gabriel
75382 Paris, Cedex 08
or APO NY 09777
(33) 14-2 96 12 02
Germany: Deichmanns Ave.
5300 Bonn 2 or APO NY 09080
(49) 228-3391
Finland: Itainen Puistotie 14A
SF-00140 or APO NY 09664
(358) 0-17 19 31
Greece: 91 Vasilissis Sophias Blvd.
10160 Athens
or APO NY 09255-0006
(30) 1-721 84 01
Hungary: V. Szabadsag Ter 12
American Embassy, APO NY 09213
(36) 1-112 64 50
Ireland: 42 Elgin Road
Ballsbridge
(353) 1-68 71 22
Italy: Via Veneto 119/A
00187 Rome or APO NY 09794
(39) 6-46 741
Netherlands: Lange Voorhout 102 or
APO New York 09159
(31) 70-362 49 11
Norway: Drammensveien 18
0244 Oslo 2 or APO NY 09085
(47) 2-44 85 50
Poland: Aleje Ujazdowskle
29/31 Warsaw
(48) 22-28 30 41 9
Portugal: Avenida das Forcas Armadas 1600 Lisbon
or APO NY 09678-0002
(351) 1-726 66 00
Spain: Serrano 75 28006
Madrid or APO NY 09285
(34) 1-577 40 00
Sweden: Strandvagen 101
S-115 27 Stockholm
(46) 8-783 53 00
Switzerland: Jubilaeumstrasse 93
3005 Bern
(41) 31-437 011

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Office of International Trade
U.S. Small Business Administration
1441 L St. N.W.
Washington, DC 20416
(202) 653-7794

U.S.Trade Representative for
Europe/Mediterranean
600 17th St. N.W.
Washington, DC 20506
(202) 395-3320

U.S. Trade and Dev. Program
Room 309 SA-16
Washington, DC 20523-1602
(703) 875-4331

Office of the U.S.
Trade Representative
600 17th St. N.W., Room 100
Washington, DC 20506
(202) 395-6120

PRIVATE ORGANIZATIONS

Beyond government agencies, private organizations also offer plenty of advice, often at no charge.

U.S. Chamber of Commerce
International Division
1615 H St. N.W.
Washington, DC 20062
(202) 463-5469

Or the overseas offices of the U.S. Chambers of Commerce are another source:

Belgium: Ave. des Arts 50, Boite 5
B-1040, Brussels
(32) 2-51367709; fax (32) 2-5137928
Britain: 75 Brook St.
London WIY 2EB
(44) 1-14930381; fax (44) 1-4932394
France: 21, ave. George V
F-75008 Paris
(33) 14-7 23 70 28
Germany: Rossmarkt 12,
Postfach 100 162
D-6000 Frankfurt/Main 1
(49) 69-28 34 01; fax (49) 69-28 56 32
Greece: 16 Kanari St.
3rd Floor
Athens 106 74
(1) 36-18 385; fax (1) 36-10 170
Ireland: 20 College Green
Dublin 2
(353) 1-79 37 33
Italy: Via Cantu 1
20123 Milano
(39) 2-869 0661
Netherlands: Carnegieplein 5
2517 KJ The Hague
(31) 20-5187518; fax (31) 20-151424
Portugal: Rua De D. Estefania,
155, 5 ESQ
Lisbon 1000
(351) 1-57 25 61
Spain: Adva. Diagonal 477
08036 Barcelona
(34) 3-321 81 95; fax (34) 3-321 81 97
Switzerland: Talacker 41
8001 Zurich
(41) 1-211 24 54

American National Standards
Institute 1430 Broadway
New York, NY 10018
(212) 354-3300; fax (212) 398-0023
for information on standards, testing, and certification

American Electronics Association
1225 Eye St. N.W., Suite 950
Washington, DC 20005
Contact: Brian Wynne
(202) 682-9110

Electronic Industries Association
International Business Council
2001 Pennsylvania Ave.
Washington, DC 20003
Contact: Kevin Shannon
(202) 457-4900

International Strategies Inc.
260 Franklin St., Suite 1700
Boston, MA 02110
(800) USA-XPORT (in Mass.)

Harvard Translations Inc.
17 Arlington St.
Boston, MA 02116
Newsletter: MarketScan Europe
(617) 424-9291

continued

FOREIGN GOVERNMENT AGENCIES

Many European agencies support U.S. investment in the country and in some cases offer such benefits as tax breaks, employee-training assistance, and cash grants.

Britain: Scottish Dev. Agency
One Landmark Square, Suite 810
Stamford, CT 06901
(800) 843-7268

France: French Industrial
Development Agency
610 Fifth Ave., Suite 301
New York, NY 10020
(212) 757-9340

France: U.S. Representative
for Normandy
3790 El Camino Real 281
Palo Alto, CA 94306
(415) 855-9412; fax (415) 855-9459

France: Rouen Chamber
of Commerce and Industry
Palais des Consuls
Quai de la Bourse
76000, Rouen
(1) 33-35 14 37 27

Germany: Baden Wuertemberg
143 Bedford Rd.
Katonah, NY 10536
(914) 232-1188

The Netherlands:
The Netherlands Foreign
Investment Agency
1 Rockefeller Plaza
New York, NY 10020
(212) 246-1434

SMALL BUSINESS FEDERATIONS

These agencies are eager to work with small businesses who are thinking of expanding overseas.

Belgium: Federation
des Enterprises de Belgique
rue Ravenstein 4
Brussels 1000
(32) 2-511 5880

Britain: National Federation
of Self-employed
and Small Businesses Ltd.
140 Lower Marsh
Westminster Brg., London SE1 78E
(44) 1-928 9272

Denmark: Federation of Danish
Industries
H.C. Andersens Blvd. 18
DK-1596 Copenhagen V
(45) 1-15 22 33

France: Confederation Generale des
Petities et Moyennes Enterprises
1, ave. du General de Gaulle, Terrace
Bellini 92806 Putaux CEDEX
(33) 1-47 78 16 38

Germany: Bundesverband der
Selbstanigen E. V. Deutscher
Gewerbeverband, Coburgerstrasse 1a
D-5300 Bonn 1
(49) 228-23 20 26 28

Greece: Hellenic Organization
for Midsize Industries & Handicrafts
150 E. 58th St., 10th Fl.
New York, NY 10022
(212) 371-1425

Ireland: Small Firms Association
Confederation of Irish Industry
Kildare St. Dublin 2
(353) 1-77 98 01

Italy: Confederazione Nazionale
dell'Artigianato
Via S. Prassede 24 00184 Rome
(39) 6-47 496 1

Luxembourg: Chamber
of Commerce
7, rue Alcide de Gaspari
Luxembourg 2981
(352) 43-58 53

Netherlands:
Coordinating Institute
of Small and Midsize Companies
P.O. Box 112
1110 AC Diemen
(31) 20-90 10 71

Portugal: Camara de Comercio e Industria Portugesa
Rua das Portas de Santo Antao, 89
1194 Lisbon
(351) 1-32 179

Spain: Instituto de la Pequena
y Medician Empresa
Paseo Castellana 141
28046 Madrid
(34) 1-450 80 48

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RESOURCES

ACCOUNTING FIRMS

The international divisions of the Big Six accounting firms offer free brochures, surveys, newsletters, database access, and professional advice.

KPMG Peat Marwick
Europe/USSR Center
767 5th Avenue, 47th Floor
New York, NY 10153
Contact: Stephen Harlan
(212) 909-5596

Ernst and Young
International Business Services
787 7th Avenue
New York, NY 10019
Contact: Jean-Claude Goldenstein
(212) 773-5992

Price Waterhouse
South Wark Towers
32 London Bridge St.
London SE1 9SY
Contact: Bruce Edwards
(44) 71 939 3000

Arthur Andersen and Co.
European Business Program/U.S.
1345 Avenue of the Americas
New York, NY 10105
Contact: Frank Schwitter
(212)708-4113; fax(212)708-3630

Arthur Andersen and Co.
Avenue des Arts, 56
B-1040 Brussels, Belgium
Contact: Iain Stitt
(32) 2-5104307; fax (32) 2-5104308

Coopers & Lybrand
International Operations Dept.
1251 Avenue of the Americas
New York, NY 10020
Contact: Wieland Chong
(212) 536-2770

Delloite Touche
DRTES avenue des Arts, 27
B-1040 Brussels, Belgium
Contact: Jean-Claude Brauda
(32) 2-230 5980; fax (32) 2-230 5878

TRADE EVENTS

The U.S. Department of Commerce "Matchmaker" delegations, along with the private trade shows, will put you in touch with European agents.

Matchmaker Trade Delegation
in Amsterdam and Brussels
June 10-14, 1991
Theme: Telecommunications, lasers, and fiber optics
(202) 377-3119

Matchmaker Trade Delegation
in Zurich and Vienna
June 20-25, 1991
Theme: Process control, analytical and scientific instruments
(202) 377-0106

Matchmaker Trade Delegation
in Stockholm and Hamburg
Sept. 23-27, 1991
Theme: Environmental control equipment, lab and scientific equipment
(202) 377-8970

continued

The October 15, 1990 issue of Electronic Business is devoted entirely to the Malcolm Baldrige National Quality Award and the management of quality. Use it to plan your own award application or as a benchmark to measure where your company stands in regard to quality. Special sections include Training for Quality, International Quality, Report on Customer Satisfaction, and Quality Strategies and Resources.

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Matchmaker Trade Delegation
in Milan and Athens
Sept. 30 - Oct. 4, 1991
Theme: Telecommunications, computers, peripherals, and software
(202) 377-0584

CeBIT '91/NetWorld Europe in Hannover, Germany Theme: Office, Information and Telecommunications Technology
March 13 - 20, 1991
(609) 987-1202

IFSEC Trade Fair in London Theme: Electronic security equipment
April 1, 1991
(202) 377-8410

COMPONIC International Exhibition in Paris
Theme: Electronic Components
Nov. 18 - 22, 1991
(33) 1-49 09 64 40

PRONIC International Exhibition
in Paris
Theme: Electronic Equipment and Products Nov. 12 - 16, 1991
(33) 1-49 09 64 40

BOOKS, MAGAZINES, AND ARTICLES

The 1992 Challenge from Europe: Development of the European Community's Internal Market. Michael Calingaert (Nat'l Planning Assoc., Washington, D.C., 1988)
[*To order phone* (202) 265-7685]

1992: The EC's Internal Market Program, Manufacturer's Alliance for Productivity and Innovation. (Washington, D.C., 1990)

Exportize. (Small Bus. Foundation of America, Boston, 1990 3rd ed.)
[*To order phone (617) 350-5096*]

The World's Largest Market: A Business Guide to 1991. (Amacom; New York, 1990)

The Marketing Challenge of Europe 1992. John A. Quelch, Robert D. Buzzell, Eric R. Salama (Addison-Wesley; Boston, 1991, 2nd ed.)

Marketing Moves through EC Crossroads. John A. Quelch and Robert D. Buzzell
(Sloan Management Review; Cambridge, fall 1989, pp. 63-74)

The World is Your Market: An Export Guide for Small Business. Clark C. Cassell (Braddock Communications; Washington, D.C., 1990)

Times of London's Guide to 1992. Richard Owen and Michael Dynes (Times Books; London, 1989)

Guide to Eastern Europe: The Changing Time of the Warsaw Pact. (Times Books; London, 1990)

High Tech 1992: The Impact of the Single European Market on High-Technology Businesses. (Graham and Trotman Ltd.; London, 1989)

"Facing the Fortress: Preparing for Europe After 1992."
Sherry Buchanan
(ELECTRONIC BUSINESS,
Oct. 15, 1988)

"Go East, Young Man." Frank H. Jellinek (*Inc.* magazine, Sept. 1990)

"Selling Abroad: Learning the Ropes." H. Garrett DeYoung (*Inc.* magazine, Aug. 1988)

"Giving Direction to the Single Market." (*Financial Times,* London, Oct. 22, 1990)

"Eastern European Consumers Hunger for Electronics Products." (ELECTRONIC BUSINESS *Forecast,* Oct. 8, 1990)

"European Community: The Single Market Takes Shape." (*Business America* magazine, U.S. Department of Commerce, Washington, D.C., Jan. 15, 1990)

"Export Now: It Makes Good Business Sense." (*Business America* magazine, U.S. Department of Commerce, Washington, D.C., Jan. 15, 1990) ☐

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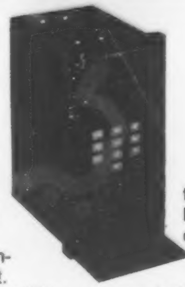
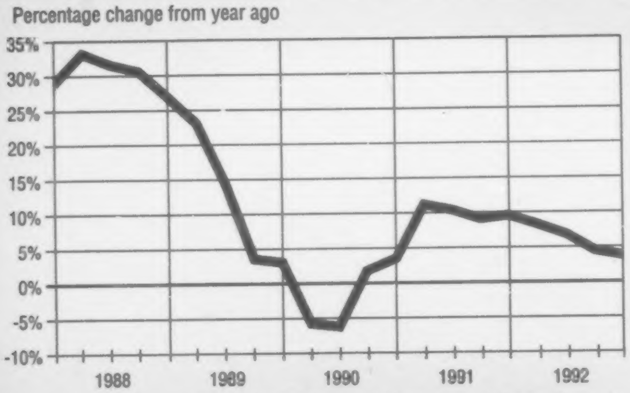
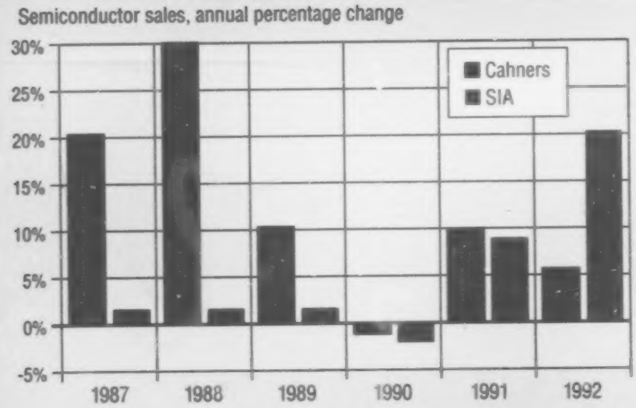


Semiconductor sales to United States



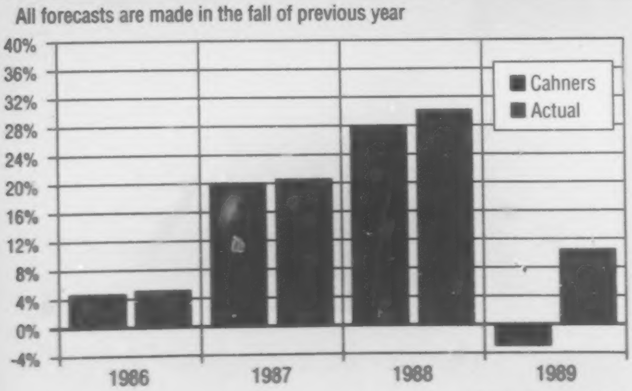
Semiconductor Industry Association: Forecast by Cahners Economics

Us vs. them



Semiconductor Industry Association: Forecast by Cahners Economics

Cahners forecast track record



Source: Cahners Economics, SIA

Semiconductor sales surprisingly strong

Recent data suggests the semiconductor slump is indeed over. New orders for semiconductors came in much stronger than we predicted three months ago in this column. Prior to the invasion of Kuwait, Cahners Economics expected semiconductor orders to rise 7% in the third quarter of 1990. As with other forecasters, economic uncertainty got the best of us, leading us to lower our forecast to only a 2% gain in the third quarter. The Semiconductor Industry Association (SIA) recently revealed that new orders actually swelled 8% to $3.62 billion in the third quarter compared with the year-ago level. The last time orders reached this high level was in the first quarter of 1989.

Semiconductor sales also saw stronger-than-expected growth in the third quarter of 1990. Sales inched up 2.1% to $3.75 billion, on the heels of two consecutive quarterly declines earlier this year. Because third-quarter data also came in stronger than anticipated, we raised our forecasts for both this year and next. Semiconductor sales are now forecast to dip only 1.3% this year and then rise 10% in 1991 and 5.8% in 1992. New orders will push up 4.8% this year, 14.4% in 1991, and 2.6% in 1992.

Our forecasting methodology relies on picking out the peaks and troughs of the next business cycle. Leading economic indicators like the ELECTRONIC BUSINESS Leading Indicator suggest business cycles in the 1990s will be shorter and milder, both in the general economy and for the semiconductor industry. While Cahners does consider new-product development in our forecasts, many experts such as the SIA tend to rely more on product innovation such as high-definition television to drive up chip sales.

Even so, the SIA and Cahners Economics expect similar growth trends in the semiconductor industry in 1990 and in 1991. Built into the SIA's forecast of 20.5% sales growth in 1992 is the assumption that the general economy will continue to accelerate through the end of 1992 with GNP rising 4%. Cahners Economics holds firm that the industry will see slower growth in 1992 compared with 1991. GNP is forecast to see a mild upturn in the first half of 1991 with growth accelerating through the end of next year. Expect GNP to rise 1.9% in 1991 and post a 2.9% gain by the end of 1992.

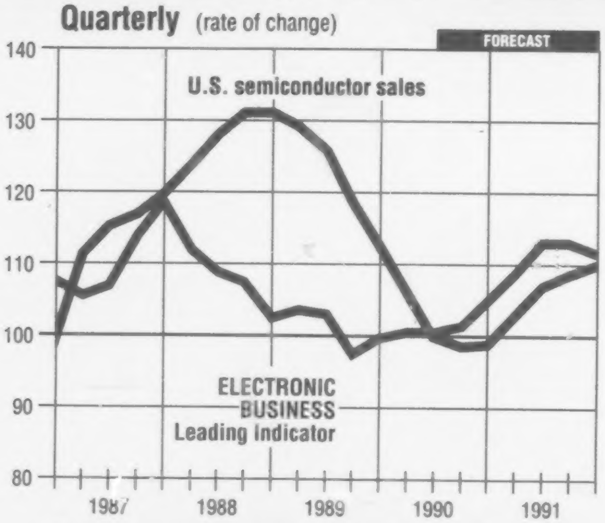
JULIE HANDELMAN

BUSINESS BAROMETER

FORECASTS FOR ELECTRONICS, COMPUTERS, AND SYSTEMS.

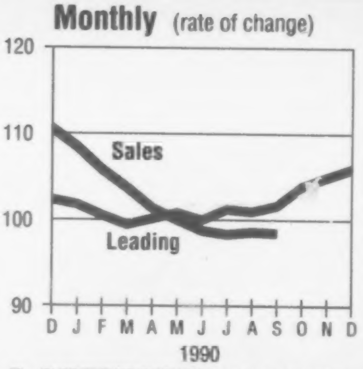
ELECTRONIC BUSINESS Leading Indicator

Quarterly (rate of change)



To obtain your complimentary copy of a 12-page background paper on the ELECTRONIC BUSINESS Leading Indicator, please contact Linda Keehn at Cahners Publishing Co., 275 Washington St., Newton, MA 02158-1630, USA, telephone (617) 630-2119, fax (617) 630-2100.

Monthly (rate of change)



The ELECTRONIC BUSINESS Leading Indicator (EBLI) finally broke the 101 barrier in September, recording its highest level, 101.6, since January. Although this is a weak rise, it is still significant in that it occurred in the post-Gulf crisis economy. However, the signals are mixed. The Gulf crisis has taken its toll on the semiconductor stock-price index, dropping from 78.2 in July to 64.1 in August and, finally, [illegible] in September. But the semiconductor bookings are on the rise, giving a good basis for the expected expansion of the EBLI. The next peak is still forecast to occur in June of 1991 at a level of 114.

Source: Cahners Economics

Electronics industry indicators this month

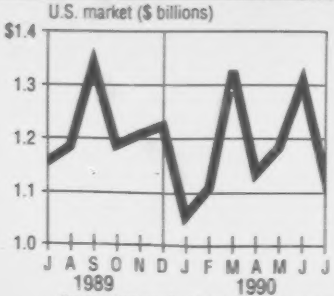
	Latest month	Previous month	Year ago	1989 average
ELECTRONIC BUSINESS Leading Indicator (rate of change, Sept.)	101.6	100.9	96.3	100.9
U.S semiconductor bookings ($ millions, 3-month average, Sept.)	$1,207	$1,238	$1,113	$1,205
Weekly hours of semiconductor production workers (monthly average, Aug.)	39.4	39.4	39.7	40.1
Electronic component lead time index (1977=100, Oct.)	64.0	80.6	75.4	102.5
S&P's semiconductor stock price index (1970=10, monthly average, Sept.)	56.7	64.1	57.5	54.7
Change in electronic-components inventories ($ millions, SA, Aug.)	-$201	+$187	+$90	-$12.8
Contracts and orders for plant and equipment ($ billions, SA, Aug.)	$38.9	$43.4	$41.7	$43.4

SA = seasonally adjusted, all other data are not seasonally adjusted

Sources: Semiconductor Industry Association, U.S. Bureau of Labor Statistics, *Electronics Purchasing* magazine, Standard & Poor's, U.S. Commerce Department, U.S. Bureau of Economic Analysis

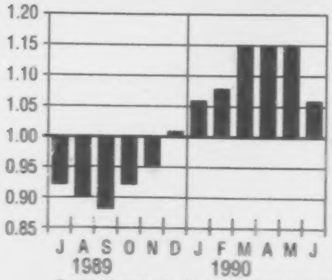
Semiconductor sales

U.S. market ($ billions)



Source: Semiconductor Industry Association

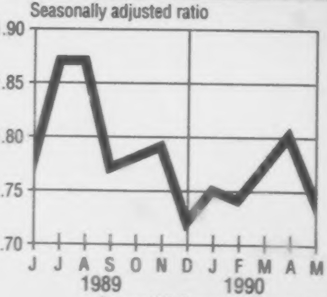
Semiconductor book-to-bill ratio



Source: Semiconductor Industry Association

Component inventory-to-shipments

Seasonally adjusted ratio



Source: U.S. Commerce Department

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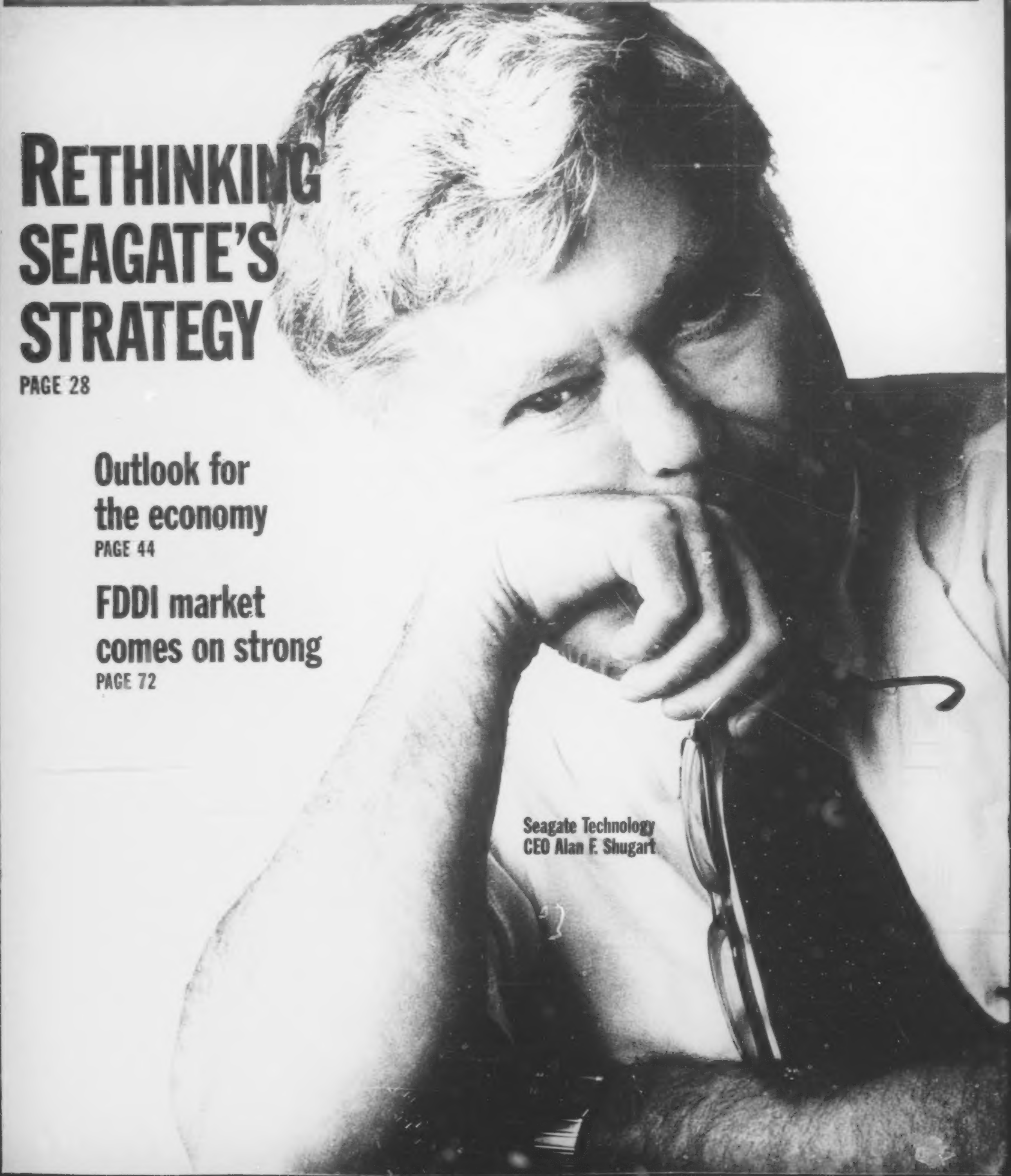

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Seagate Technology
CEO Alan F. Shugart

Electronic Business

FOR MANAGEMENT IN ELECTRONICS, COMPUTER, AND SYSTEMS COMPANIES—WORLDWIDE

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Cover: Jeffrey Dodge Rogers

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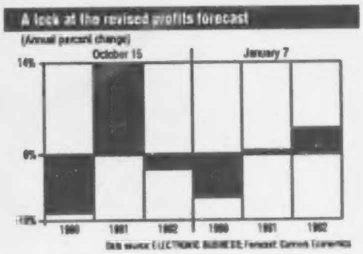

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Making our issues "reader-friendly"

The claim "transparent to the user" is one of those claims advanced—*ad nauseam* and often with scant justification—by software developers pushing their products. This poetic phrase can be translated into everyday English: "You don't have to know how it works or watch weird symbols flash before your eyes; just enter simple commands and get the information you need."

Ever-vigilant copy editor Elaine Cummings

Magazines don't advertise their "user transparency" for the same reason software companies don't brag that their products won't crash your computer system. It is assumed that this will be the case, that it is a user's (reader's) basic right. A magazine that asks its readers to struggle with clumsy syntax or to bridge gaps in the information forfeits its right to their attention. That doesn't mean "transparency to the reader" is easy to achieve, especially in a publication that combines business and technology. Just ask Elaine Cummings, copy editor and de facto dean of user transparency at ELECTRONIC BUSINESS. "The challenge is making sure that it is grammatically correct, technically sound, and reads like Hemingway," she says.

Elaine is a recent, welcome addition to our staff, arriving with a background in both teaching and business publishing. After sizing us up, she quickly drafted a style guide to ensure that our spelling, punctuation, sentence structure, and nomenclature remain clear and consistent. Every story is the object of her ceaseless vigilance, and neither gratuitous business jargon nor acronym-clotted technical obscurity is permitted to escape her computer terminal.

This particular issue of ELECTRONIC BUSINESS has been a test of that vigilance, ranging as it does from the technological high ground to the clamor of the marketplace. Elaine has had to deal simultaneously with stories on the future uses of digital signal processing, the emerging standards for fiber distributed-data interface, and the new marketing strategy of giant disk-drive manufacturer Seagate Technology.

Perhaps the biggest challenge in this issue has been our economic outlook ("A stalled economy batters electronics growth"). Managing editor Bruce Rayner interviewed economists across the opinion spectrum to produce best-case, worst-case, and consensus forecasts. An accompanying array of charts and graphs provides a quick grasp of where the experts believe various sectors of the electronics industry are headed.

One thing transparent to almost all users of our economy is that tough times lie ahead. Just how tough? Read on.

JOHN PARKER, section editor

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tion, the boom times are not over. More than 125,000 made the annual pilgrimage to Las Vegas for Comdex, exceeding the 1989 turnout of 118,000. The 1,850 exhibiting companies, up 7% from 1989, occupied some 2.2 million square feet of floor space, an 18% increase from one year earlier.

Nevertheless, apprehension was evident at the show about the state of the economy and the query "How's business?" was more than a friendly greeting.

Fujitsu Microelectronics Inc., for example, has been girding for an economic slowdown since early 1989 and has been keeping a tight rein on its expenses, according to Rich Christopher, senior vice president and general manager of the company's integrated circuits division in San Jose. But Christopher said the company has seen little confirmation of a downturn beyond slower sales in the second quarter of 1990. And the executive pointed to a recently opened semiconductor plant in Japan as evidence that the company has decided to continue purchasing capital equipment.

Peter M. Craig, vice president of Rainbow Technologies Inc., an Irvine, Calif., supplier of computer security products, said he talks to his top 100 customers on a regular basis, and most are waiting for the other economic shoe to drop. "It seems like [the economy] is doing better than everybody had feared," he said. "But there are a lot of yellow flags flying out there."

"Business has not been robust," acknowledged David P. Berry, new product development manager for Maxell Corp. of America. He says that shipments of floppy disks from all vendors were "down dramatically," in 1990 over 1989. As floppy disks go, he reasons, so goes the computer industry.

Comdex also reflected the current fortunes—or misfortunes—of individual companies. Traffic was light at the booth operated by ailing Unisys Corp. while a speaker at Wang Laboratories Inc.'s booth preached to nearly empty rows of chairs.

In contrast was Microsoft Corp. whose booth was constantly packed with showgoers checking out applications for the company's new Windows 3.0 graphical user environment.

RICK WHITING

EUROPE

Philips has company in fiscal misery

POOR PHILIPS. For months it flooded stockholders and the media with the latest bulletins on its restructuring until discovering in November that—whoops!—its 1990 losses would be double its earlier estimates. This, just months after agreeing to pay $9.3 million to settle a case brought by U.S. investors over Philips NV's failure to notify them of its fiscal woes in the first place.

The revised warning pegged the net loss for 1990 at $2.4 billion, although optimistically, Philips predicts profitability in 1991. Earlier, the company announced it would lay off up to 20% of its global workforce of 285,700.

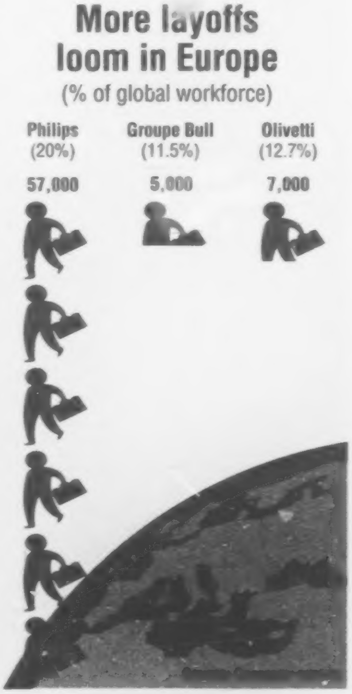
One of its first businesses to restructure is semiconductors, which was separated from the Components Division as of the first of January. The new semiconductor products division is led by Heinz Hagmeister, formerly head of the IC business unit. Already there is talk about a possible joint venture with Matsushita, which cooperates with Philips on a lighting product joint venture in Japan. Matsushita could fill the capacity at an underutilized chip plant in Nijmegen since Philips left the SRAM business.

Philips isn't the only European company in serious trouble. In November Ing. C. Olivetti & Co. announced plans to slash 7,000 workers from its global force of 55,000. The Italian giant's sales were running ahead of last year's, and unlike Philips, the company is still profitable. Olivetti was hit by the downturn in European computer sales and the sharp appreciation of the Italian lira against the dollar. Sales growth for personal computers in Europe slumped to less than 5% in the third quarter of 1990.

Facing losses as high as $800 million in 1990, Groupe Bull is aiming for profitability in 1992 by sweeping away most jobs not directly related to R&D, manufacturing, sales, and service. It announced layoffs of 5,000 workers, including 2,000 non-manufacturing jobs in the United States. About 1,000 jobs from its Bull HN headquarters in Massachusetts will be cut. Bull is closing 7 of its 13 plants by 1992.

At the same time, Bull increased its R&D spending for its new Zenith Data Systems unit by 25%, boosted by French government subsidies. It also is shifting focus to software-application packages and computer services. The company is looking for partners in non-core businesses, such as peripherals, which it spun off in the hope of attracting equity.

BARBARA BERKMAN


More layoffs loom in Europe
(% of global workforce)

UNITED KINGDOM

U.K. opens telephone services to competition

U.S. COMPANIES will be able to sell their telephone services in Britain because of a new government proposal to liberate the telecommunications services market.

The major beneficiaries are Baby Bells that took shares in British television cable companies, which now can sell basic telephone services, as can the operators of cellular networks, satellites, and private communication networks.

A stalled economy batters electronics growth

Are we in a recession? If so, how bad will it be? ELECTRONIC BUSINESS takes a critical look across the spectrum of economists' views

BY BRUCE C. P. RAYNER

One thing is for sure: The U.S. economy is now at the end of the longest peacetime expansion—roughly eight years—since the government began recording business-cycle fluctuations during the 1850s. Citing shaken consumer confidence and the scuttling of many business investment plans for 1991, many economists now believe that the nation has entered a recession. A recession is usually defined as two or more consecutive quarters of negative GNP growth.

Business leaders today are more concerned with estimating the length and severity of the downturn. But that is not an easy prediction to make since there are many variables to consider, some relatively clear cut, and others undetermined. At least three complex factors could dramatically impact the nation's economic health:

- **Rising oil prices.** A war in the Middle East would threaten oil supplies and play havoc with energy prices, intensifying inflation and slowing the economy even more. If a full-scale war in the Persian Gulf breaks out, a recession would last at least four quarters and maybe longer, say many economists;
- **An over-leveraged banking system.** Banks are being pinched by falling real estate prices, intensified re-regulation, and increases in bad credit risks. The result is a general perception by banks everywhere that lending should be curtailed. Add to that the prospects of additional bank failures;
- **The federal budget deficit.** If European and Japanese banks withdraw their money from U.S. capital markets in order to prop up their own slowing economies, the U.S. government would be forced to raise interest rates to attract the funds back, further slowing an economic recovery in the United States.

The role these factors would play in slowing economic growth is far from certain. In this report, ELECTRONIC BUSINESS presents a range of opinions and scenarios from the optimists, the pessimists, and the consensus. In general, the industrial and business economists tend to fall into the optimist category, while bank and financial economists take a more pessimistic view.

Where does ELECTRONIC BUSINESS stand? We believe that the most realistic forecast for 1991 is somewhere on the optimistic side of the consensus view. Barring a major Middle East conflict, we believe the national economic recession will be relatively short—no longer than two or three quarters.

On an industry level, we anticipate that most segments of the electronics industry will see solid single-digit growth through 1991. ☐

THE CONSENSUS

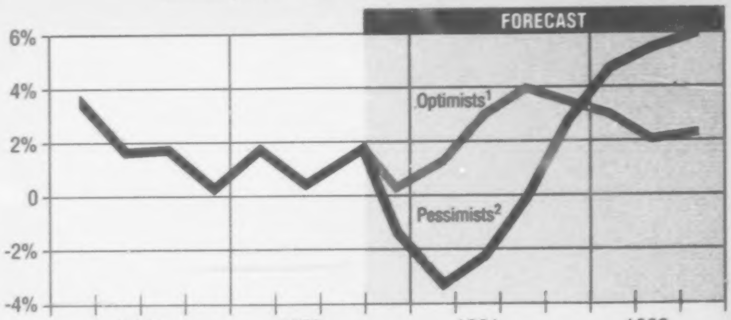
For the first time since June 1982, the Nov. 10 issue of the *Blue Chip Economic Indicators* newsletter printed its headline in red. That means the majority of the 55 economists surveyed now believe that real GNP growth has dropped below zero.

In all, 80% of the Blue Chip panel members say a recession started in the fourth quarter of 1990 but will last only about two or three quarters and will be relatively mild. GNP growth in 1991 will average around 0.5%, according to the Blue Chip consensus.

Consensus reports all predict more or less the same thing: slow GNP growth in the first half of 1991 coupled with sluggish consumer spending and a mild slowdown in business activity. A mid-year pickup in economic activity is expected as oil prices start to fall and consumer and business confidence returns. Industrial production will be flat next

GNP growth

(annual percentage change on a quarterly basis)



Source: Commerce Dept., ¹Cahners Economics, ²A. Gary Schilling & Co. Inc.

quarter and post a 2.2% growth in the third quarter and 3.2% growth in the fourth quarter.

On the positive side of the economic picture is the trade sector. Although the Canadian and the U.K. economies are sluggish, other countries are expected to maintain reasonable growth through the year. That is good news for U.S. exports, which will continue to show signs of strength while imports will grow more slowly.

In a recent consensus of 71 macroeconomic forecasters, the National Association of Business Economists (NABE) projected the 1991 real trade balance in the United States to be less severe than previously expected due to a lower dollar and weak domestic demand. Last May, NABE forecast the 1991 trade deficit at $40 billion but has since lowered its estimate to $31 billion.

Chris Probyn, associate director of forecasting at Data Resources Inc., agrees that the export sector will remain one of the bright spots on the economic horizon. "The lower value of the dollar is the reason for the mildness of the recession," he says. GNP growth will be a negative 2.1% this quarter and won't turn positive until the third quarter, according to DRI.

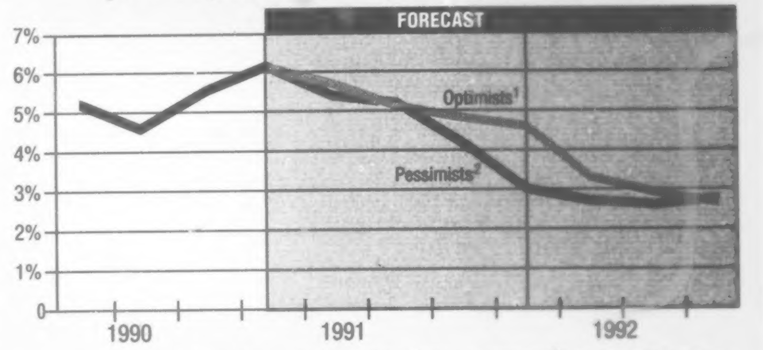
Like most consensus-minded economists, Probyn assumes that there will be no war in the Middle East. Oil prices will start their descent this quarter and will be back down in the $20-a-barrel range by mid-1992. The recent decline in consumer confidence was largely a result of the spike in oil prices, Probyn says. As prices come down, consumer spending is expected to rebound.

Maybe, maybe not. The consumer sentiment index, a broad measure of consumer opinion compiled by the University of Michigan, fell 24.3 points from July to 63.9 in October, the steepest three-month fall in 44 years. The value is still above the all-time low of 51.7 recorded in May 1980, but the index is expected to fall even further than its current level.

The consensus view on inflation, as measured by the consumer price index (CPI), is that it will moderate from around 6% in late 1990 to below 5% by the end of the year. This decline is largely the result of the drop in oil prices. DRI expects the CPI to fall to below 3% by the end of the year. The Blue Chip consensus puts the fourth quarter CPI figure at 4.4%.

Inflation rates

(consumer price index, quarterly growth rates from year ago)



Source: Bureau of Labor Statistics, [1]Cahners Economics, [2]A. Gary Schilling & Co. Inc.

On the industrial front, many economists believe that business cycles in the 1990s will be much more muted than in the 1970s and early 1980s, largely because of better inventory management. An exception is the retail sector, where an inventory overhang is still too high. Some economists expect a sluggish retail sector through much of the year. Everett Erhlich, vice president of economic and financial planning at Unisys Corp., believes both the financial and retail sectors are destined for further restructuring.

There are advantages and disadvantages to this muted business cycle. On the plus side, there are no violent gyrations in employment and business activity. Management has much better visibility of slowdowns and can adjust production accordingly before crises develop. On the negative side, softer business cycles imply that slow-growth periods will be more protracted than in the past. That includes 1991 growth. The Blue Chip consensus puts industrial production growth for the year at a meager annual rate of 0.6%, down from a 1.1% 1990 estimate.

As for policy initiatives, most of the consensus economists believe the Federal Reserve Board has done a good job of managing monetary policy. The challenge now is whether the Fed can stay the course. The consensus believes that the Fed should loosen the reins on monetary policy by dropping the discount rate still further and easing bank reserves.

As far as the technology sector is concerned, most industry economists believe that the days of divergent growth paths between the economy and the technology sector are gone. There are indicators that business investment in computers and telecommunications equipment are determined by macroeconomic trends. The good news is that the business investment sector will, for the most part, not suffer severely. □

THE OPTIMISTS

Optimistic economists believe the recession is either nonexistent or will be so short as to be not worth worrying about. The fourth quarter of 1990 may have seen negative GNP growth, they say, but growth will pick up in 1991 and may average 2% for the year. Optimists believe there are no fundamental weaknesses in the economy.

These economists say that the violent swings in the business cycle are a thing of the past. "The recessions of the 1990s will be so different from those of the 1970s and 1980s that the same word should not be used to describe them," says Jim Haughey, vice president of economics and research with Cahners Economics and a self-professed optimist.

Haughey points to three fundamental shifts in the business environment that mark the end of the traditional business cycle: a freer and more open international trading environment; the financial deregulation of the 1980s that allows capital to flow more readily into non-mortgage investments; and more sophisticated inventory management.

While the optimists do not forecast a boom—they predict growth through the early 1990s to average between 2% and 3%—they do not see a bust either. Manufacturing capacity utilization is running in the low 80% range, close to where it was in 1982 when the expansion began. That means utilization is still high enough to maintain a healthy level of business investment. Cahners Economics predicts business fixed investment will post annual growth rates of 2% in 1991 and 4.3% in 1992.

Brian Wesbury, vice president and economist with The Chicago Corp., points to strength in both the supply and demand sides of the economy as a basis for his 1991 GNP growth forecast of 2%. On the supply side, Wesbury points to continued healthy gains in productivity rates. While the productivity growth rate is down from a mid-1980s high of 1.75%, it is still hovering around 1%, he says. Productivity gains lead to higher output and higher GNP.

On the demand side, Wesbury believes the Federal Reserve Bank's monetary policy in 1990 has been relatively expansionary. This acts as a stimulant to economic activity. As evidence he points to the drop by 0.75% of the Federal Funds' interest rate in the last year and a 10% growth in the monetary base. As a rule of thumb, the lag between monetary policy stimulation and higher economic activity is about nine months.

It is very unlikely that the economy will move in the opposite direction of monetary policy. But that doesn't mean that it could not happen this time. One thing worrying the optimists is the fact that October 1990 saw a slowing economy even though the fundamentals were in place—industrial output fell 0.8% during October while employment fell by 68,000 jobs and U.S. plant capacity utilization dropped to 81.7%.

The reason for the poor results, says Wesbury, was "psychological factors," namely falling consumer confidence. But most optimists project that prices will fall and consumer buying will resume leading to a pickup in business activity. "I am not certain how long consumer confidence can stay low," says Wesbury, "but the fundamentals are in place for strength in 1991."

Another concern is the re-regulation of the banking sector. If the banking system is stymied in its role to create investment and growth, then the economy could face problems ahead. At issue now is an attempt by Congress to increase insurance costs on deposits by 4%. The effect will be a crimping of banks' operating profits and a higher cost of borrowing money. "If our forecast is wrong," says Wesbury, "it will be because of over-regulation of the banks." □

THE PESSIMISTS

Not all pessimists are alarmists. But unlike their optimist brethren, they look at the economy and see threats rather than opportunities. For the most part they look beyond the conventional economic indicators to more basic structural issues—in this case a weakened banking sector. While they have been out of favor throughout the 1980s, they are now coming into their own. Forecasts for GNP growth in 1991 among this group of economists range from positive 0.5% to negative 3%.

"The range of uncertainty has never been greater in the post-war years," says Donald Ratajczak, director of the economic forecasting center at Georgia State University. Oil prices are the major concern at this juncture in the economic slowdown, but close behind is the problem of the financial sector's liquidity, he says. While Ratajczak expects banks to "muddle through" the slowdown, he sees a risk to economic stability should there be any bank failures. The forecasting center at Georgia State is projecting GNP growth of zero to 0.5% for 1991.

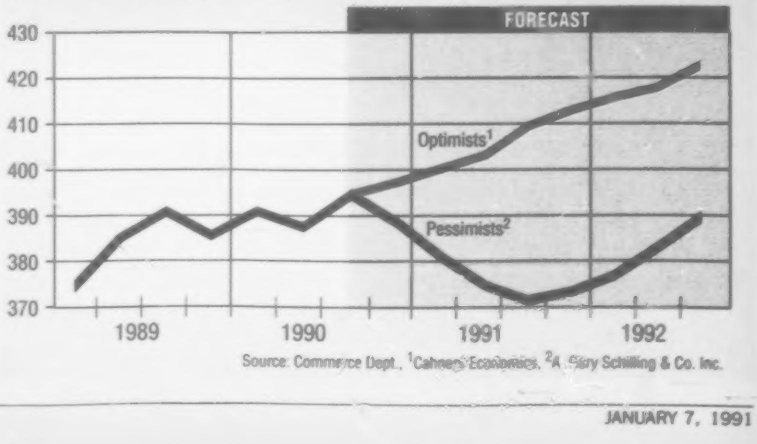
Ratajczak is an optimist of a sort compared with some pessimists. "We have probably been in a recession since late 1989," asserts Gary Schilling, economist and president of A. Gary Schilling & Co., a New York-based forecasting firm. He expects continued downward revisions to the anemic GNP numbers for much of 1990—maybe even back into 1989—and he predicts GNP growth for the year at a negative 3.0%.

Schilling's thesis is that the current U.S. economic downturn is different from others the country has experienced in that it is first and foremost a "balance sheet" recession; that is, the rise in the economy's debt burden in the 1980s—bank under-collateralized debt, an explosion of leveraged buyouts through junk bonds, rising consumer debt, and troubled Third-World debt—is out of control. But as current economic activity slows due to rising oil prices and falling consumer confidence, the recession has spread to the economy's "income statement"—the GNP accounts that include consumer spending and business investment.

The combination of the two aspects of recession could be devastating. As the economy slows, so does cash flow and the country's ability to service its debt, so a downward spiral ensues. An over-leveraged economy increases the risk of bank

Business investment

(non-residential fixed investment, producers' durable equipment, billions of 1982 dollars)



Source: Commerce Dept., [1]Cahners Economics, [2]A. Gary Schilling & Co. Inc.

failures and the increasing inability of the government to stem a tide of pessimism and panic. Pessimists like to draw parallels between the 1990s and the 1930s.

On the positive side, growth in demand for debt is dropping, says John Langum, president of Business Economics Inc., in Chicago. (Langum prefers the label "realist" over "pessimist.") But he points to a drop in the growth rate of debt as evidence that demand is dropping sharply. Household debt growth fell from 7.4% in 1989 to 6% in the second quarter of 1990, while non-financial business debt fell from 6.7% to 4.0% over the same period. Langum expects a negative 2% GNP growth in 1991.

While optimists point to inventory management, business investment, and the international trade sector as solid in 1991, pessimists are not so sure. Residential construction—a primary leading indicator—has failed to turn the corner after dropping at a 15.4% annual rate in the third quarter of 1990. That is the sixth quarterly decline out of seven quarters for residential construction.

Nor do the pessimists indicate much hope for growth in business investment, either. A leading indicator of business spending is corporate cash flow, which provides the incentives—profit growth—and the means—retained earnings—for capital spending, says Schilling. But for the last few years, net cash flow has been falling as the slowing economy squeezes margins. Fixed investment, while not dropping yet, is expected to contract over the next few quarters.

Pessimists agree that management's control of inventory has improved considerably but doubt whether this is sufficient to avoid sharp drops in industrial production should the economy sink into a deep recession.

And on the international front, the trade balance will show continued improvement, but not because of a growth in exports. It will be the result of fewer imports. Export growth averaged 5% in late 1990 and could well slow in 1991 as foreign economies head south—Canada, Australia, and the U.K. are already in recession and continental European countries and maybe Japan could head into a recession sometime this year, say pessimists. ☐

Electronics outlook: slow and steady

As with economic forecasts, electronics market forecasts tend to diverge greatly. Because ELECTRONIC BUSINESS tends to take a fairly sanguine view about the economy in 1991, this year's market forecasts reflect a fairly upbeat year ahead. While growth overall in the 1990s is expected to be slower than during the 1980s, 1991 will nonetheless see solid single-digit growth rates in most sectors.

There are no fundamental signs that demand for electronics will suffer to any great extent in the near term. Still, there is no denying that corrections are being made. The semiconductor book-to-bill ratio, on a three-month moving average basis, dipped from 1.0 in August to 0.95 in October. That means a slowdown in chip business as shipments of chips are outpacing new orders. Forecasts for chip production in 1991 range from slightly negative growth to slightly positive.

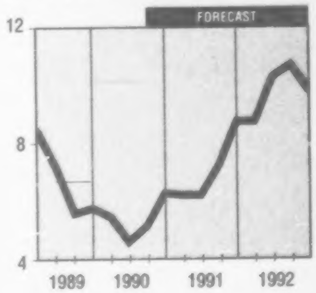
According to Cahners Economics, total electronics production, shipment, orders, and capacity bottomed out in the fourth quarter of 1990 and will post modest gains throughout the year and into 1992. The University of Michigan forecasts business investment in information-processing equipment to grow about 5% in 1991.

ELECTRONIC BUSINESS's generally positive sentiment is reflected by industry executives. "I don't see evidence of the slowdown," said Leon Machiz in mid-November. As chairman and CEO of Avnet Inc., the largest electronics distributor in the United States, and middle man for much of the electronics component industry, we believe he has a better-than-average window on demand and supply pressures. ☐

The U.S. Electronics Industry

Production

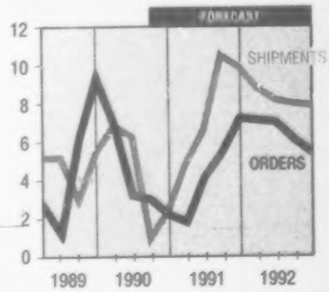
(quarterly percentage change from year ago)



Source: Federal Reserve, Cahners Economics

Shipments and orders

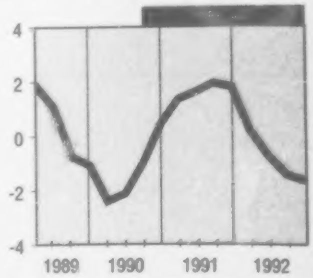
(quarterly percentage change from year ago)



Source: Department of Commerce, Cahners Economics

Industry capacity utilization

(percentage change)



Source: Federal Reserve, Cahners Economics

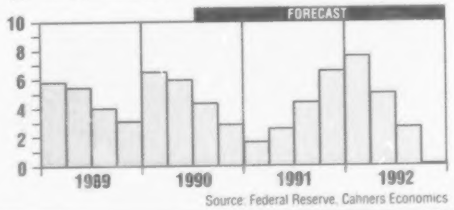
Electronics Outlook for 1991 and 1992

Electronic Components

The recession is hitting the components industry hard right now, but growth is expected to pick up later in the year. Shipments and orders growth bottomed out last quarter, and production is in the trough this quarter.

Growth in production

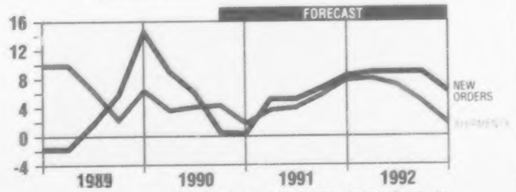
(quarterly percentage change in production index from year ago)



Source: Federal Reserve, Cahners Economics

Growth in shipments and orders

(quarterly percentage change from year ago)



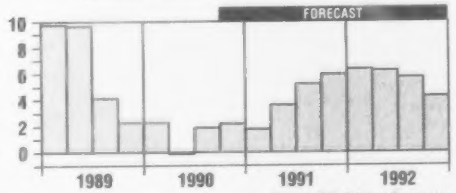
Source: Department of Commerce, Cahners Economics

Instruments and Controls

The instruments and controls market bottomed out in the fourth quarter of 1990 and will post solid growth through 1991 and into 1992. Production growth will top out at a 6.3% rate in the first quarter of next year.

Growth in production

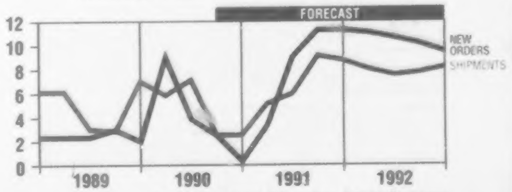
(quarterly percentage change from year ago)



Source: FRB, Cahners Economics

Growth in shipments and orders

(quarterly percentage change from year ago)



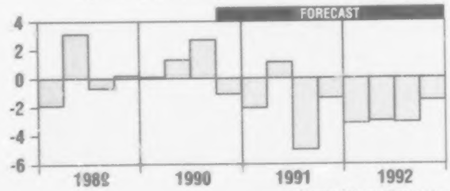
Source: Department of Commerce, Cahners Economics

Military Electronics

Despite the need for retrofitting and the trend toward higher electronics content, military electronics will see contraction throughout the decade. In 1991, shipments are expected to post negative growth.

Growth in military electronics shipments

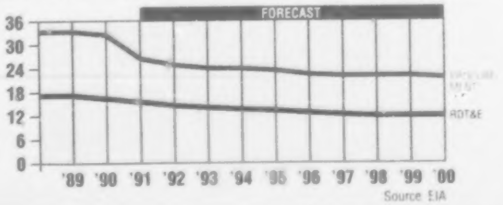
(quarterly percentage change from year ago)



Source: Cahners Economics

Defense electronics

(electronic content of defense budget in billions of constant FY 1991 dollars)



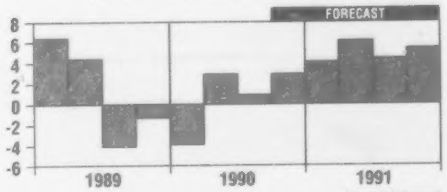
Source: EIA

Semiconductors

The experts say that business cycles in the semiconductor industry will be shorter and milder in the 1990s. Still, growth in 1991 could reach a quarterly high of 10%. As for the book-to-bill ratio, expect stability around 1.0 for most of the year.

North American semiconductor consumption

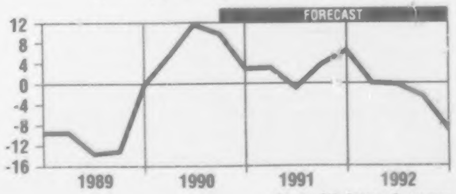
($ in billions, quarterly percentage change)



Source: Dataquest

North American semiconductor book-to-bill ratio

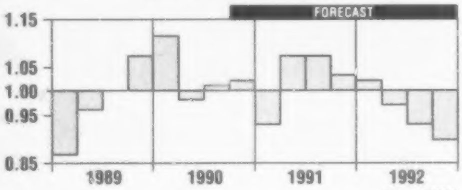
(quarterly percentage change from year ago)



Source: SIA, Cahners Economics

Electronics Distributors

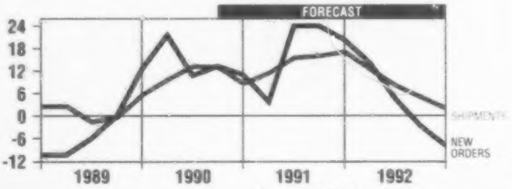
The bellwether of the electronics industry, electronics distributors will see a pretty steady book-to-bill ratio for most of 1991, with shipments and orders growth peaking in the second half of the year.



Distributors' book-to-bill ratio

(ratio of shipments to orders)

Source: NEDA



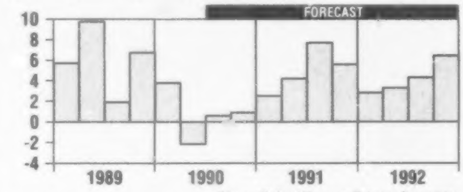
Growth in shipments and orders

(quarterly percentage change from year ago)

Source: NEDA, Cahners Economics

Consumer Electronics

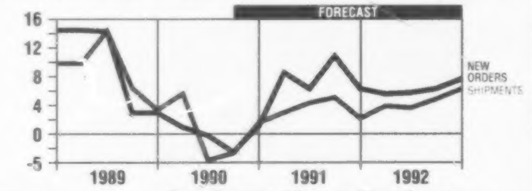
The U.S. television and radio market can expect only slow growth in 1991. But after the contraction of 1990, any positive growth is encouraging. Orders will peak in the third quarter of the year.



Growth in production

(quarterly percentage change from year ago of U.S. T.V. and radio market)

Source: Federal Reserve, Cahners Economics



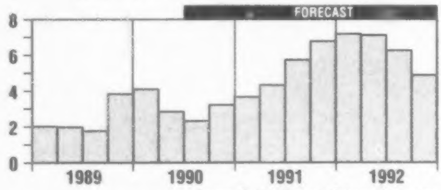
Growth in shipments and orders

(quarterly percentage change from year ago of U.S. T.V. and radio market)

Source: Department of Commerce, Cahners Economics

Communications Equipment

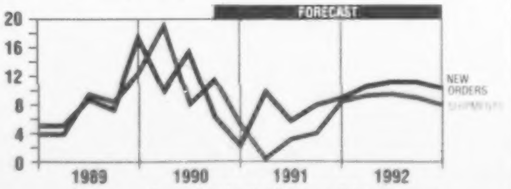
After a steady decline in 1990 of order and shipments, the commercial communications equipment market will post steady growth in 1991. Production too will pick up. The market driver is primarily non-U.S. demand.



Growth in production

(quarterly percentage change from year ago)

Source: Federal Reserve, Cahners Economics



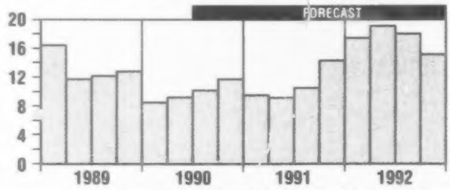
Growth in shipments and orders

(percentage change from year ago for non-defense communications)

Source: Department of Commerce, Cahners Economics

Computer and Office Equipment

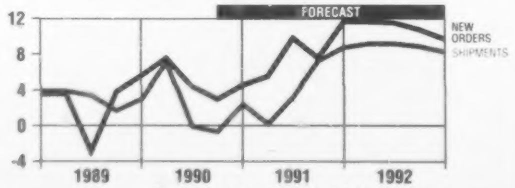
The computer and office-equipment market will be stable and slightly up in 1991. Activity will be strongest in the pocket, notebook, and laptop markets, with the mainframe and minicomputer markets continuing to languish.



Growth in production

(quarterly percentage change in production index from year ago)

Source: Federal Reserve, Cahners Economics



Growth in shipments and orders

(quarterly percentage change from year ago)

Source: Department of Commerce, Cahners Economics

DSP is giving all the right signals

A range of strategies emerge as vendors try to bring digital signal processing to the masses

BY PETER BURROWS

They already are a fundamental reason for the sound clarity of your CD player, the enhanced graphics of your laser printer, and the increased functionality and speed of your modem. In a few years, digital signal processors (DSPs) could be the enabling technology behind continental digital cellular-telephone networks, multimedia computers, and such futuristic gizmos as filmless cameras, tapeless phone answering machines, and semiconductor-size electronic mufflers.

DSPs are single- or multichip devices that can be coupled with analog-to-digital converters to accept, compress, improve, store, transmit, or otherwise manipulate analog signals such as sound, light, and radar. While the rest of the semiconductor industry settles into a projected growth rate of 14.3% through 1995, DSPs are slated for 27.9% compounded annual growth during that time, creating a DSP market of $3 billion, according to market analyst Will Strauss of Forward Concepts in Tempe, Ariz.

But the DSP market is not yet ready to join the ranks of mega-volume semiconductor segments such as microprocessors or dynamic RAMs. Market growth has been constrained by formidable product complexity, a tentative customer base, and lack of vendor support. "DSP is still kind of a black art, and there are only a few hundred magicians in the world who really understand its power," says David Wong, president of Spectron Microsystems Inc. of Santa Barbara, Calif., which sells a DSP operating system called SPOX. "The secret is to make that power available to the many thousands who can make the best use of it."

That transformation is happening, slowly but surely. Vendors of programmable general-purpose DSPs—including Texas Instruments Inc., Motorola Inc., AT&T, Analog Devices Inc., and NEC—have been slugging it out since the mid-1980s to see who could provide the best development tools to make the design of DSP applications as easy as possible for customers. Strauss expects this $284 million general-purpose segment of the DSP market to grow to $1.3 billion by 1995.

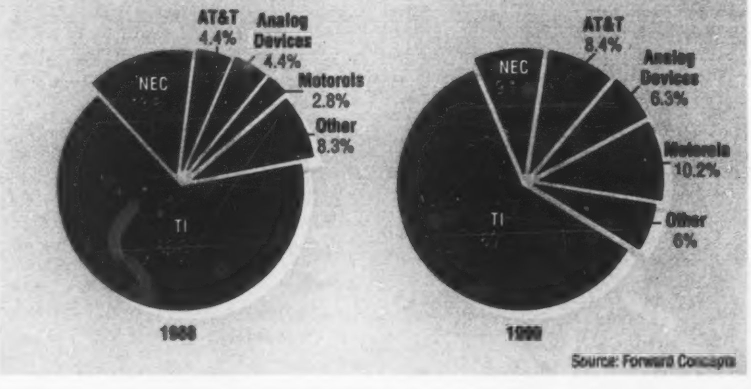
More recently, some innovative U.S. niche players and selected Japanese chip-makers have begun offering nonprogrammable plug-and-play solutions that electronics manufacturers in selected vertical markets can incorporate into high-volume products such as modems, copiers, and telephones. Forward Concepts expects this $390 million FASIC (function and algorithm-specific IC) market to grow to $1.3 billion or so by 1995.

The snowballing interest in DSP has also spurred the development of an industry infrastructure. Third-party support for DSP users by add-on applications-development board vendors and software design-tool vendors is about a $90 million business in the United States, says Strauss.

The upshot of all this activity is that electronics designers from audio to avionics are becoming more knowledgeable about DSP technology and are increasingly putting it to work. Major markets include:

- **Computing**: While Steven Jobs's use of a general-purpose DSP from Motorola in his Next workstation has been a commercial disappointment to date, insiders say that he gave momentum to a trend—almost every major computer-maker has either signed a contract to incorporate DSP technology into their systems, or they have expressed an interest to do so. Initially, this would furnish computers with the video-compression capability necessary to store memory-

DSP's big five



Source: Forward Concepts

hogging motion-video files; later in the decade, DSPs will drive full-fledged multimedia computing. Forward Concepts projects this DSP segment to grow from $8 million in 1990 to $250 million in 1995;

- **Telecommunications**: A battle is already under way to supply the DSPs for the digital cellular-phone networks that will be installed in the next decade, beginning in Europe this year. DSPs improve transmission quality through editing techniques such as echo cancellation, and they expand line capacity by compressing signals into one-third of their analog bandwidth;
- **Consumer products**: Along with existing markets in office equipment, CD players, and electronic games and toys, vendors gush over future opportunities in speech processing, advanced-definition television, and digital audio tape recorders. The DSP Group Inc. in San Jose, for example, recently had its chips designed into Sanyo transcription machines that replay recordings at any speed without distorting the speaker's voice.

It took a lot of investment and proselytizing by TI and others to bring the market to this point, since making DSPs is a technical challenge that requires extensive mathematical skills and expertise in both analog and digital design. TI has revolutionized the market by pioneering the use of easy-to-use PC-based development tools in the early 1980s. Since 1983, the company has also offered free training to professors, discounted software and textbooks, and sponsored classes at over 200 universities to inspire interest. "TI did the dirty work for the rest of the industry," says Strauss. "Until recently, almost all of the of the designs you saw at technical conferences came out of TI."

But rapid market growth has not meant profits for most DSP vendors, managers report. Sources say that TI has the only profitable general purpose DSP operation in the world, and the company reportedly did not turn a profit until 1987—seven years after its first product introduction.

A Japanese retreat from DSP market

Although U.S.-based Advanced Microsystems Inc. is credited with introducing the first general-purpose digital signal processor in 1978, it was the Japanese who dominated the commercial DSP market in its early years. By 1980, NEC Corp. was offering the most reliable product on the market and the lowest prices. By 1983, NEC—along with Fujitsu Ltd., Oki Semiconductor, and Ricoh Co. Ltd.—controlled about 90% of the commercial DSP market in the United States, says market analyst Will Strauss, president of Forward Concepts in Tempe, Ariz.

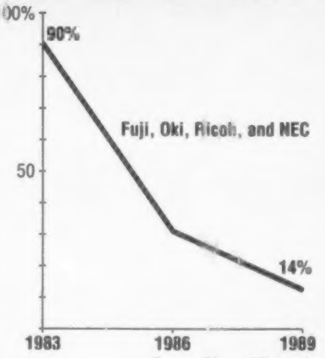
Today, Fujitsu, Oki, and Ricoh have all but abandoned the U.S. market and NEC appears to be faltering. The four companies now control less than 15% of the market, says Strauss, having been burned by their own lack of customer support and competitive applications-development tools. "In Japan, customers look to the vendor for applications development," says Strauss. "But here, we want to design our own stuff, and the [Japanese companies] just don't have the support in place."

"We are not a factor in the [standard-products] marketplace," says Ron Gadway, product marketing manager for Fujitsu Microelectronics Inc. in San Jose. "Frankly, I've told top management not to market the product proactively until I can support it. There is no sense telling people to knock on the door if I have to turn them away." Fujitsu's DSP sales have fallen from around $2 million in 1988 to under $1 million this year, sources say.

Gadway and other managers of U.S. subsidiaries find themselves in no-man's land as U.S.-based market leaders such as Texas Instruments Inc. and Motorola Inc. put the squeeze on smaller DSP competitors. Management is often unresponsive to calls from their U.S. subsidiaries to send money or DSP experts based in Japan. "Since they don't set all of our budgets, we have to decide on our own priorities, and DSP is simply not worth the effort," says Gadway. "We get a lot more return on investment in other areas with a lot less manpower."

Japan's departure from general purpose DSPs

(percentage of U.S. market)



Source: Forward Concepts

Japan's foray into the U.S. DSP market has not been a total failure. Relatively little has been spent on the ventures to date, analysts say, yet systems makers including Fujitsu, NEC, and Ricoh have improved their ability to make low-cost DSP devices for use in their own products. And all target nonprogrammable applications-specific DSPs called FASICs (function and algorithm-specific ICs) at high-volume customers with a need for low-priced, plug-and-play DSP modules.

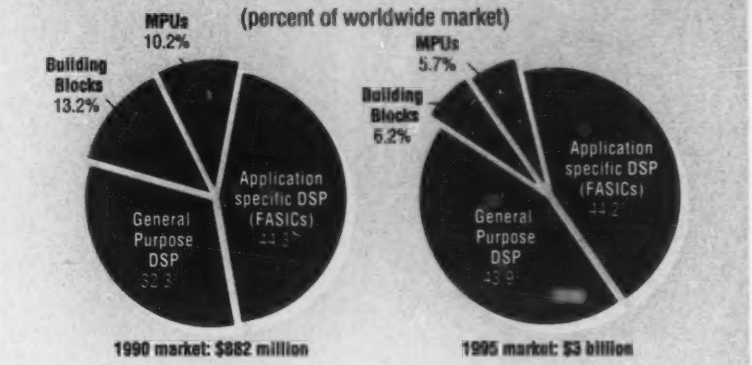
"We are not getting out of the DSP market," says Jerry Gora, technical marketing manager with Oki Semiconductor. "We are just repositioning. TI may want to be everything to all people, but we are taking a rifle-shot approach to marketing, not a shotgun approach."

But others question the long-term viability of an applications-specific strategy when the price performance of programmable general-purpose chips is improving so rapidly. "The people who can use [FASICs] really love them now, but the customer base is too narrow," says Bryant Wilder, DSP operations manager for Motorola. "Sooner or later, we will take those markets as well." ☐

One reason for the meager returns is the sheer complexity of DSP technology itself. A DSP chip can be thought of as a microprocessor unit with a one-track mind—dedicated to rapidly executing complex DSP algorithms, often in real time. Packed with very-large-scale-integration technology, high-end DSPs can reach speeds of 275 million instructions per second. Engineers with the training to design these racehorses command salaries upwards of $50,000 right out of graduate school. "Just to compete costs tens of millions of dollars per year, and I am not even talking about fabs and corporate marketing," says Michael Hames, TI's DSP department manager in Houston. "I am just talking about new designs and tools."

Strong growth for DSP

(percent of worldwide market)



Source: Forward Concepts

TI and the competition

Despite increasing competition, TI is now in position to reap its harvest. The company already controls over 60% of the programmable market, according to Forward Concepts, and that percentage should slip only slightly as rivals try to steal market share in a growing market. TI offers 25 device types ranging from $3 to $200 each, 10,000 customers, and support from 1,000 third parties, says Hames. "And we have the highest volumes, allowing us to have a maniacal focus on reducing costs."

As a result, TI's pursuers have for the most part targeted new users of DSP technology. Here is a rundown on those vendors' efforts:

- Motorola's dominance in mobile-communications systems makes it a favorite in digital cellular-telephone and other communications markets. The company's Austin-based DSP Operations group has doubled its sales in each of the past two years, says Strauss, making it the fastest-growing competitor and the second-largest programmable DSP supplier, with a 10.2% market share;
- While AT&T is also a natural for communications, the company has had problems selling commercial semiconductors and could also be constrained by its relative lack of third-party support. Still, huge internal demand, volume contracts with such companies as Finland's Nokia Group, and the vaunted support of Bell Labs' research-and-development resources give AT&T staying power in DSP. The company plans to attack high-margin markets such as multimedia computing and office-communications equipment, says DSP applications engineer Frank Ferro;
- Analog Devices, built on decades-old expertise in mixed-signal technology, needed only three quarters to exceed its 1990 goal of acquiring more than 400 contracts. The company plans to first attack the communications markets, says DSP marketing manager Henry Davis;
- Having lost market share in recent years, NEC plans to take a higher profile to highlight the company's 10-year involvement in DSP, high-quality manufacturing, and under-publicized but substantial support programs, says NEC's DSP product line manager George Wang. Still, NEC's products are said to be hard to use and lack support from overextended third-party vendors who see NEC's DSP platform on the downturn.

These programmable standard-part DSP vendors have until now approached their market as if it were a traditional standard-parts semiconductor market: All have invested heavily in R&D and manufacturing in an effort to drive down prices, enlarge demand, and limit competition. But as with the microprocessor markets in the 1970s and 1980s, the key to market growth lies in software.

"We have learned from the PC industry that applications won't come out of the woodwork until there are software standards," says *Spectron's* Wong, who has so far drawn the support of TI, Motorola, and Analog Devices for his company's SPOX DSP operating system. While DSP vendors want to expand the size of the pie, he says, "the bottleneck is the applications software."

For now, the relative lack of commercial software is giving suppliers of product-specific non-programmable devices an advantage with customers who don't want to do their own applications programming. An example is Zoran Corp., which became profitable after seven years by locking up a number of undisclosed deals with major Japanese systems manufacturers. "The high-volume guys want canned solutions," says Levy Gerzberg, Zoran's president. "They need inexpensive, highly-integrated solutions with short development cycles, and they don't want to write code."

"Your average systems designer has no DSP experience," says Geoff Philips, director of DSP product marketing at Harris Semiconductor in Melbourne, Fla., which has been moving into the FASIC market since 1987. "But his company probably wants to move into it very fast, so he has to train himself and use inefficient commercial software aids to get the job done. We want to give him a black box that has all that knowledge embedded inside."

Other observers find long-term chinks in this FASIC strategy. "As time goes on, reprogrammable devices will become a more effective solution," according to analyst Andrew Rappaport, president of Boston-based Technology Research Group. "As the price of standard products comes down and the quality of development software goes up, there is less reason to go to an application-specific solution." □

FDDI comes on strong as networks run out of room

Market heats up as computer-systems vendors join the ranks of suppliers offering fiber-optic products

BY DWIGHT B. DAVIS

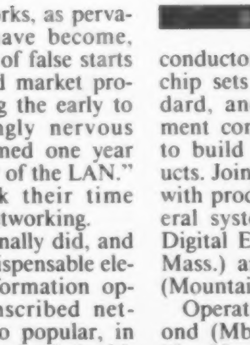
Local area networks, as pervasive as they have become, share a history of false starts and exaggerated market projections. During the early to mid-1980s, increasingly nervous LAN vendors proclaimed one year after the next "the year of the LAN." Users, however, took their time warming up to local networking.

But warm up they finally did, and today LANs are an indispensable element of corporate-information operations. The circumscribed networks have become so popular, in fact, that many are overloaded with users and traffic. The result has been an environment in which an emerging fiber-optic-based LAN technology—the Fiber Distributed-Data Interface, or FDDI—may actually keep pace with analysts' optimistic growth predictions.

Among those forecasts is a Dataquest Inc. estimate that predicts the number of FDDI connections will grow from about 30,000 units shipped this year to 950,000 by 1994, with revenue from these shipments projected to grow from $150 million to $1.3 billion during that same period.

Shipments of FDDI connections

(units and revenue)



Source: Dataquest Inc.

A spectrum of vendors has coalesced to provide FDDI products. They include semiconductor companies manufacturing chip sets based on the FDDI standard, and communications equipment companies that use the chips to build various networking products. Joining the FDDI ranks in 1990 with products of their own were several systems companies, including Digital Equipment Corp. (Maynard, Mass.) and Sun Microsystems Inc. (Mountain View, Calif.).

Operating at 100 megabits per second (Mbps), FDDI can serve as a "backbone," linking slower-speed LANs such as Ethernet (10 Mbps) and token-ring (4 Mbps or 16 Mbps) networks. FDDI can also run as a LAN itself, although bringing its fiber-optic connections directly to users' desks is still too costly for all but the most demanding applications. Sun's FDDI controller, for example, lists for $12,500.

Others cost much less. With discounts, the average selling price for FDDI connections is now about $6,500, says Marty Palka, Dataquest's senior industry analyst for networks. At first, pre-chip-set FDDI connections cost three times that or more; further, chip development will keep prices heading southward.

Advanced Micro Devices Inc. in Sunnyvale, Calif., hit the market first with an FDDI chip set—the Supernet 1—in 1988. The five-chip Supernet 1 initially cost $590 in quantities of 1,000; it now sells for $295 in the same quantity and has won more than 150 design-ins worldwide, says Basil Alwan, FDDI product marketing manager at AMD.

This month, AMD is scheduled to begin shipments of its second-generation FDDI chip set, the Supernet 2. With more features, lower power and space requirements, and a price of $225 in 1,000-unit quantities, Alwan estimates that the new product may cut the end-user price of a single attachment FDDI station by $1,000.

AMD is not alone in offering the FDDI standard in silicon. National Semiconductor Corp. in Santa Clara, Calif., introduced its own five-chip FDDI solution last April and is currently developing a two-chip second-generation product. Digital Equipment also designed FDDI chips early on and has licensed their manufacture to AMD and Motorola. Both companies are already supplying Digital with chips, and each has the option to offer the components on the open market as well.

Making FDDI affordable

The long-term goal of the chip developers and their OEM customers is to bring down the cost of FDDI connections to a much more affordable level. "We need to get to the $1,000 to $1,500 level by 1993 if we are going to meet the market projections," says Karen Parker, FDDI applications manager at National Semiconductor.

Reaching this pricing goal could prove difficult, since a large percentage of a connector's cost falls outside the realm of the FDDI chip sets. As much as one-third of the cost can be tied to the components that provide the fiber-optic linkage. The circuitry that interfaces the controller to the networked system can account for another third.

Most of the current FDDI product marketing centers on higher-level concentrators, bridges, and routers rather than on individual workstation controllers. Because these other devices support entire networks of users, or link different types of networks together, the high costs of FDDI can be better amortized.

Proteon Inc. in Westborough, Mass., for example, sells a router designed to interconnect different types of LANs to one another as well as to the outside public network. The product, the P4200 router, sells for $12,000-$15,000 without its FDDI option, and for $25,000-$27,000 with it, says Nate Kalowski, vice president of marketing.

Big LAN on campus

FDDI bridges and routers such as the P4200 are, for the most part, being purchased for "campus" networking applications. In these, the FDDI network serves as a backbone superhighway linking Ethernet and token-ring LANs within a single building or among a group of buildings. Internetworking vendor Cisco Systems Inc. in Menlo Park, Calif., has sold more than 350 FDDI routers, with the vast majority serving in such campus backbone configurations, says Brent Bilger, FDDI product manager.

Like routers and bridges, concentrators can connect directly to the FDDI backbone, but they can also function as central hubs that support a number of LAN spokes. Some intelligent concentrators support multiple types of LAN spokes and, as such, permit users to grow gradually into FDDI as their networking needs expand.

Digital Equipment, for one, sells a hierarchy of FDDI products that permit users to migrate into the FDDI environment. Existing Ethernet LANs can connect to the DECbridge 500, a $25,000 device that translates between Ethernet and FDDI protocols. The bridge, in turn, is connected to a DECconcentrator 500, which links directly to the FDDI backbone network.

Connecting individual FDDI users to the FDDI backbone through a concentrator has the advantage of isolating the main FDDI backbone from disruption should a workstation malfunction, says Karl Pieper, FDDI product development marketing manager at Digital Equipment.

With the growing influx of FDDI products, ensuring that different vendors' devices work with one another has become an industry priority. Different implementations of the FDDI specifications—even products based on the same chip sets—can meet the standard but still fail to interoperate.

Most vendors conduct their own in-house testing between their products and those of other suppliers. In addition, AMD and the University of New Hampshire each run interoperability testing laboratories to determine if products meet the basic FDDI standard and if they can communicate with other FDDI products.

Many compatibility problems center on a portion of the standard called Station Management (SMT), the only part of the FDDI which is not yet ratified. SMT has gone through several revisions as part of the standard-development process, with the most recent version designated as SMT revision 6.2.

A hurdle to SMT's ratification is backward-compatibility with earlier versions, says R. Bruce McClure, chairman of Synernetics Inc. in North Billerica, Mass. Synernetics licenses its SMT software implementation to companies unwilling or unable to develop their own and also sells FDDI hardware products. If the final SMT version is forced to be backward-compatible, the specification's features may be unduly constrained, McClure believes. Those vendors that have installed FDDI products based on the earlier SMT specs argue that the final version can't abandon present users.

The resolution of the SMT problem remains uncertain, but few think that it threatens the widespread acceptance of FDDI.

"The systems vendors definitely legitimize the market," says AMD's Alwan. "Up to now, we have had to push FDDI into the marketplace. Now, user demand is starting to pull vendors into the market." ☐

Fiber and copper promise cheaper FDDI

The high cost of fiber distributed-data interface prompts suppliers to search for low-cost implementations of the standard. Two working groups within the American National Standards Institute (ANSI) committee responsible for FDDI are taking different paths toward that end.

One group hopes to develop a less-expensive version of the standard by specifying lower-power optical components. This version would still operate over fiber-optic cable, but the distance a signal could travel would be limited to about 300 feet.

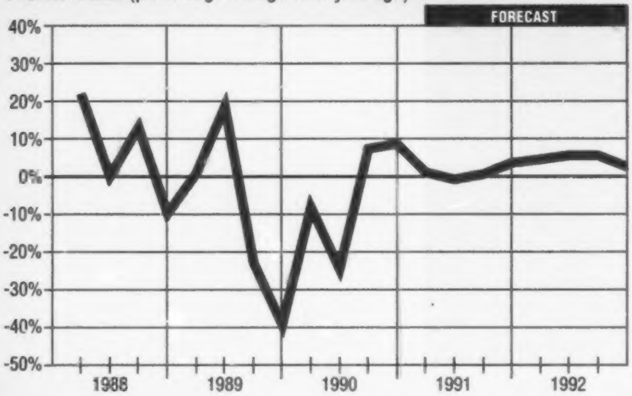
The second working group's goals are more radical: They hope to operate FDDI over twisted-pair copper cabling, thereby eliminating the cost of optical components altogether. Many observers once doubted that twisted-pair wiring could support 10-megabit-per-second Ethernet speeds, much less FDDI's 100 Mbps. Several vendors claim to have successfully tested copper implementations of FDDI, however, and a number are developing twisted-pair products.

The ANSI working groups hope to have their respective proposals on their way to ratification by December 1992, according to R. Bruce McClure, chairman of Synernetics Inc., who chairs the low-cost fiber implementation working group. He and others worry that the marketplace could become confused if too many proprietary solutions appear before the standards evolve. Steve Bell, manager of the LAN Business Development Group at National Semiconductor, acknowledges this concern but says, "We are tracking the standard as closely as possible in our [joint] development program with Cabletron Systems."

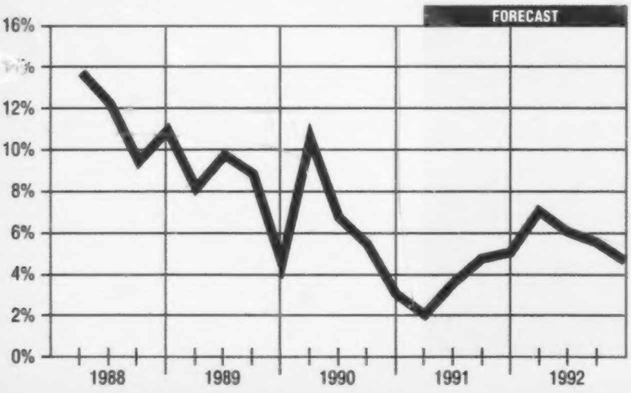
Another wild card in the push for low-cost FDDI solutions is the ongoing price drop for standard fiber-optic components. "If the price for electro-optical converters drops appreciably in the coming years, it will lessen the demand for alternative fiber-optic and twisted-pair solutions for FDDI," says Karl Pieper, FDDI product development marketing manager at Digital Equipment Corp. ☐

ELECTRONIC BUSINESS indexes

Profits index (percentage change from year ago)



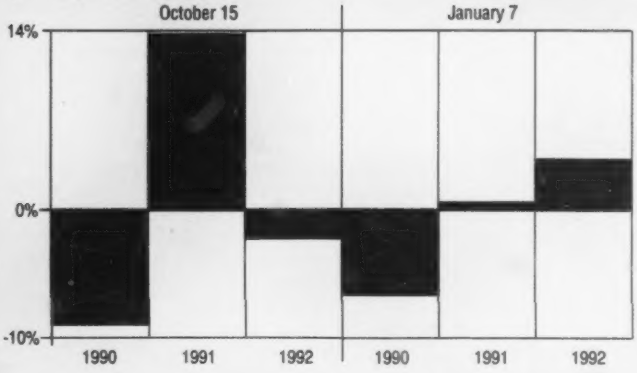
Revenue index (percentage change from year ago)



Data source: ELECTRONIC BUSINESS; Forecast: Cahners Economics

A look at the revised profits forecast

(Annual percent change)



Brush with recession repaints profit picture

Despite all the recent bad economic news, electronics industry profits performed better than expected in the third quarter of 1990. According to the ELECTRONIC BUSINESS profits index—a tally of 17 representative electronics companies' balance sheets—profits rose 6.8% last summer from year ago levels. ELECTRONIC BUSINESS economists had predicted that profits growth would be steady. All in all, this was a sharp turnaround from the 25% year-ago decline in profits that occurred in the spring. Assuming the final quarter of 1990 stays on track, we expect the final damage in 1990 profits to be a 7% loss from 1989 levels.

The question continues to loom: Will profits be eaten away in 1991 by the recession-threatening events of the past few months? Three months ago this forecaster was adamant that electronics industry profits could and would rebound with 14% growth in 1991. Alas, continued uncertainty about the impact of the Persian Gulf crisis in the final months of last year has had a worse effect on the economy than had been predicted. The recession could still be averted, but the odds of rapid, solid economic growth in early 1991 have become extremely slim.

Instead the ELECTRONIC BUSINESS economic scenario now calls for only a 0.6% increase in electronics profits next year. The reason the profits forecast has been downgraded has everything to do with business and consumer confidence. The recovery that had clearly begun for electronics distributors and semiconductor manufacturers is being short-circuited by a lack of confidence and the subsequent cutback in spending. It appears now that all the cost controls in the world will not help profits growth hit the double digits.

However, the weakness in profits that is now expected in 1991 means 1992 profits will be better than previously expected. The bite we will see this year will be healed in 1992 as sales once again rebound following the long 1990-1991 hiatus. So electronics profits have been revised upward to 4% growth in 1992.

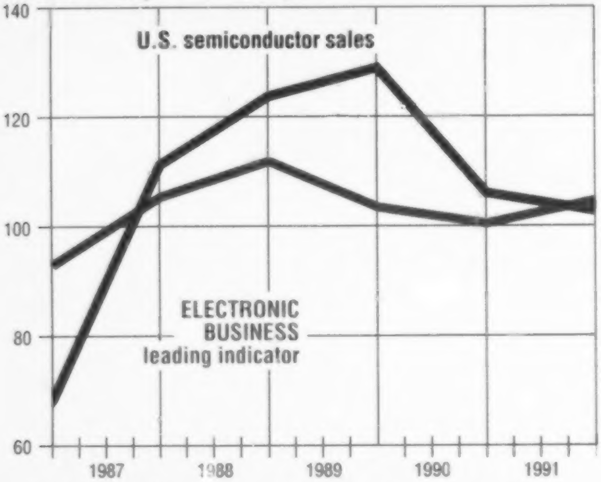
ELIZABETH B. BAATZ

BUSINESS BAROMETER

FORECASTS FOR ELECTRONICS, COMPUTERS, AND SYSTEMS

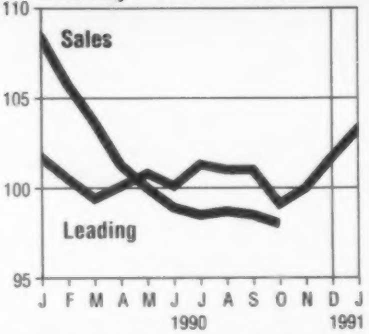
ELECTRONIC BUSINESS Leading Indicator

Quarterly (rate-of-change)



To obtain a complimentary copy of a 12-page backround paper on the ELECTRONIC BUSINESS Leading Indicator, please contact Linda Keehn, Cahners Economics, Cahners Publishing Co., 275 Washington St., Newton, MA 02158-1630 USA, telephone (617) 630-2119, fax (617) 630-2100.

Monthly (rate-of-change)



The ELECTRONIC BUSINESS Leading Indicator (EBLI) dropped a point to 99.1 in October. We had been forecasting EBLI would be showing a definite slow-growth expansion by this time, but instead the past three months have shown no increase. The holding pattern of EBLI does not indicate a significant cyclical rebound for electronics in 1991. Nor, however, does it indicate a recession. We now expect EBLI to peak at a modest 111.1 level in August of 1991 (compared to 114 in June 1991 that we had forecast three months ago). The mild rebound will be even milder than our first predictions.

Source: Cahners Economics

Electronics industry indicators this month

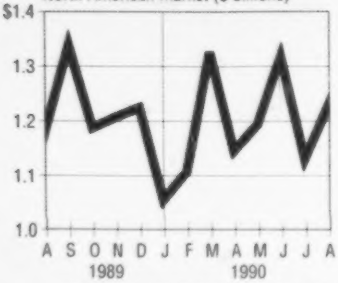
	Latest month	Previous month	Year ago	1989 average
ELECTRONIC BUSINESS Leading Indicator (rate-of-change, Oct.)	99.07	101.03	97.05	100.9
U.S. semiconductor bookings ($ millions, 3-month average, Oct.)	$1,198	$1,214	$1,109	$1,205
Weekly hours of semiconductor production workers (monthly average, Oct.)	40.8	39.4	40.5	40.1
Electronics components lead time index (1977 = 100, Nov.)	80.5	64.0	94.2	102.5
S&P's semiconductor stock price index (1970 =10, monthly average, Oct.)	52.0	56.7	58.7	54.7
Change in electronics components inventories ($ millions, SA, Sept.)	+$55	-$186	-$123	-$12.8
Contracts and orders for plant and equipment ($ billions, SA, Sept.)	$42.2	$39.4	$41.6	$43.4

SA = seasonally adjusted, all other data are not seasonally adjusted

Sources: Semiconductor Industry Association, U.S. Bureau of Labor Statistics, *Electronics Purchasing* magazine, Standard & Poor's, U.S. Department of Commerce, U.S. Bureau of Economic Analysis

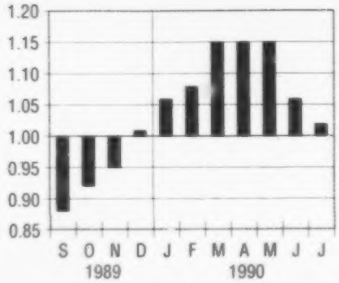
Semiconductor sales

North American market ($ billions)



Source: Semiconductor Industry Association

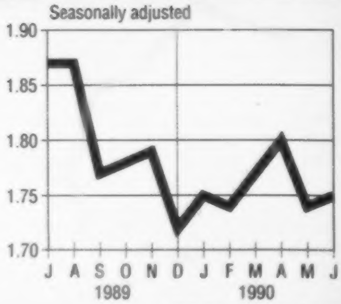
Semiconductor book-to-bill ratio



Source: Semiconductor Industry Association

Component inventory-to-shipment

Seasonally adjusted



Source: U.S. Commerce Department

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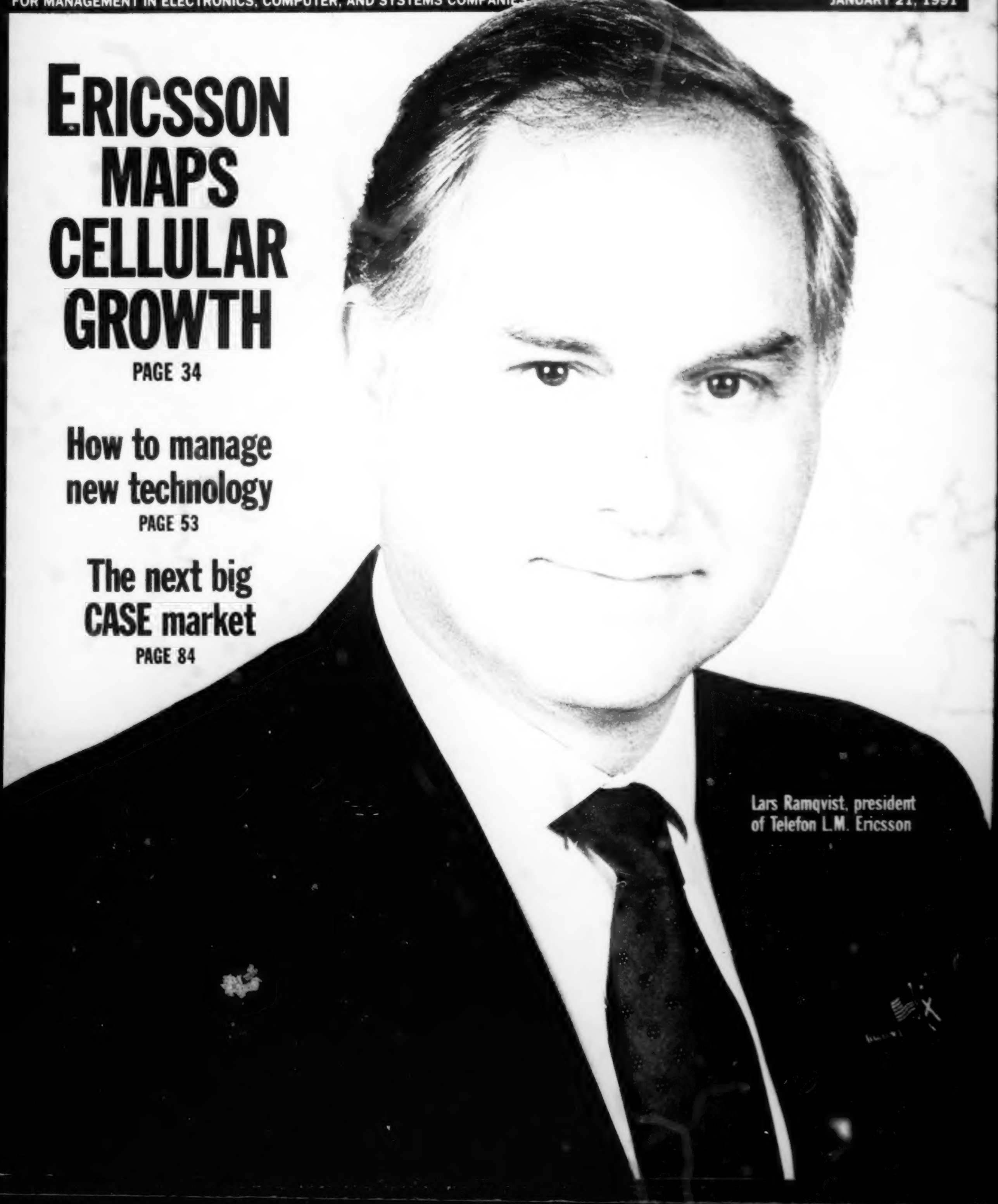

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How to manage new technology

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The next big CASE market

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Lars Ramqvist, president
of Telefon L.M. Ericsson

Electronic Business

FOR MANAGEMENT IN ELECTRONICS, COMPUTER, AND SYSTEMS COMPANIES—WORLDWIDE

VOL. 17, NO. 2

JANUARY 21, 1991

PAGE 34 President Lars Ramqvist: Ericsson "has to face the market as one company, not as six divisions"

COVER STORY/ERICSSON

34 Ericsson adapts to deregulated global market

Sweden's electronics giant has responded to telecommunications deregulation with a major overhaul that made it far more entrepreneurial and market-driven. The radio communications division is now the fastest-growing business, outstripping the success of Ericsson's traditional core business in public switches

Cover: Peter Damroth

UPDATE

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Apple's new RISC venture; AT&Tackers at the gate; portables lead Japan's PC exports; Jessi opens door to IBM; European software demand helps U.S.; DAT versus DCC in tape-format faceoff; final farewell at Data General; European defense companies feel pinch; changes in Baldrige guidelines

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ERICSSON

34 Ericsson adapts to deregulated global market

The demand for cellular technology is paying off for Ericsson, which has amassed a 40% share of the global cellular market. By the end of the decade, the company's share could reach 50%, which by then will add up to some 100 million subscriber lines, predict analysts

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38 How Silicon Systems turns yen into dollars

Acquisition by a Japanese company may seem like a tragedy to some, but it brought a new lease on life for Silicon Systems Inc. Investment by Tokyo-based TDK Corp. already has paid off for SSI with production of a programmable filter IC pegged to hard-disk drives, reportedly the first single-chip device to perform this function

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With product breakthroughs every few months, it is all too easy to be left in your competitors' dust. Here are some companies that excel at predicting and managing new technology and integrating the technology into marketable new products

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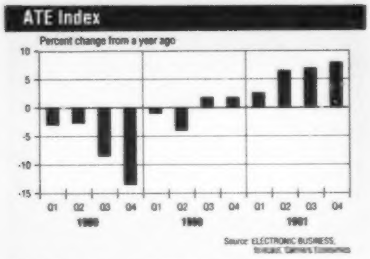
63 Rad spreads risk through product diversification

Rad Data Communications has taken niche production to a very successful extreme. The Israeli company's engineers tap distributors for their wish lists of perfect products, then develop them at the rate of one new product every two weeks. Rad's annual growth rate: 50%

PAGE 63 Rad's Ami Amir complains that high U.S. volumes come at the expense of profitability

1989 computer revenue
($ millions)

PAGE 73 Exports account for 90% of Taiwan's PC production, so the worldwide slowdown hurts



Source: ELECTRONIC BUSINESS forecast, Cahners Economics

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PAGE 53 Only about 2% of researchers are true innovators, claims Beckman's James Osborne

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73 A tough road ahead for Taiwan's PC makers

It's a small world: A Taiwan government official recently warned that the nation will lose 5% of its exports to the United States if America's economic growth falls by 1%. But the weakening of the world economy is not the only thing worrying Taiwan's PC makers

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81 Multibus II stages comeback in communications

A technology in search of applications; that was the plight of single-board computer bus architecture Multibus II after VMEbus appeared in volume. But new markets may provide Multibus II with the steam it needs to compete

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Manufacturers of computer-aided software engineering products are finally tuning in to their customers biggest problem: MIS maintenance. The result may be a remedy for disappointing sales of conventional CASE products

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INSIDE BUSINESS

Riding the wave of technological change

Imagine electronics product development as a day at the beach: sunny, 80 degrees, wind steady, waves cresting at regular intervals, the big swells visible a mile out. Simple, predictable, no hassle.

Well, that was yesterday or the day before. This is today: A new generation of products appears every six months, and the average product life cycle is only 18 months long. It still takes you two years to get your product from drawing board to distributor, so it's already obsolete. The competitors are circling offshore. Surf's up.

Dave Webb: on the job in Silicon Valley

Managing technological change is the leitmotif of this issue of ELECTRONIC BUSINESS. If your taste in metaphor runs more to *Star Trek* than to surfing, consider the words of Michael Swavely, president of North America Compaq. From his perspective, the computer industry is changing "at warp speed." That means "you simply can't plan products two or three years in advance," Swavely told managing editor Garrett DeYoung. Swavely's insight provided, among other things, a headline for Garrett's story in this issue's Managing Resources section.

Fortunately, Garrett reports, even small companies can learn to predict—and catch—the next technology wave. So can some very large companies. From London, senior editor Barbara Berkman reports that a reorganized Telefon L. M. Ericsson—Sweden's largest electronics group—is shaking off bureaucratic habits and capturing important territories in the U.S. and European cellular communications markets.

Nowhere does the technological wave roar louder than on the shores of Northern California. Patrolling those shores for ELECTRONIC BUSINESS is no one-person job—even for senior editor Teri Sprackland. We are pleased to welcome Dave Webb who, as associate editor, will work with Teri in our San Jose office.

Dave's beat is microcomputer systems, and he is well qualified to cover it. As West Coast storage and systems editor for Digital News, he wrote about hardware and software products of interest to DEC users. As a reporter for Computer Systems News, Dave covered both storage and image-processing markets.

His feature contribution to this issue fits right in with the managing-technology theme. It is the saga of Multibus II, the single-board computer bus architecture that went aground after competing technology took to the seas. Dave reports that the rising tide of demand for telecommunications and data communications applications may yet rescue Multibus II. Welcome aboard, Dave.

JOHN PARKER, section editor

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BPA ABP

expected to create a feeling of confidence in AT&T on the part of NCR people."

Mergers within the computer industry have a poor track record, even when they have been friendly. Unisys Corp. continues to struggle four years after its creation through the combination of Burroughs Corp. and Sperry Corp., the computer industry's largest merger.

IBM's acquisition of telecommunications vendor Rolm Corp. never lived up to expectations. AT&T's own investments in Sun Microsystems Inc. and Ing. C. Olivetti & Co. have produced less than spectacular results.

AT&T's failed foray into the computer market has cost the company more than $2 billion since 1984. What it needs, more than a product line or an installed base, is management experience in the computer industry. Unless it treads carefully, AT&T could lose NCR's most valuable assets and find itself with a $6 billion albatross.

RICK WHITING

PERSONAL COMPUTERS

Portables take the lead in Japan's PC exports

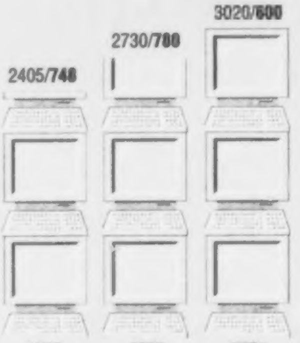
U.S. PC MAKERS can expect to see greater numbers of advanced portable personal computers made by their Japanese competitors hit the world marketplace, despite the fact that Japan's growth in overall PC exports has been slowing.

Japanese PC makers produced 327,000 laptops and notebook PCs in the first quarter of 1990, obtaining a 86% quarterly growth rate in production of those categories of PCs, according to a recent report by the Electronics Industry Association of Japan (EIAJ). The Japanese fiscal year begins April 1.

Japan's total PC production in the first quarter of fiscal 1990 reached 644,000 units. Of the 160,000 PC units exported in that quarter, 110,000 were portables, or 69% of the country's total PC exports. It was the first time Japan exported more portable PCs than desktops. In terms of sales, portable PC exports generated $193.8 million, or 85% of the quarter's $226.8 total PC export revenue. Although the quarter's PC export revenue increased 20%, the total number of PCs exported declined by 6%, mostly because Japanese manufacturers have quickly upgraded from 8-bit to 32-bit microprocessors. According to the EIAJ report, the quarter's production of 8-bit-based personal computers dropped 57%, while the 32-bit models registered 79% growth, and production of 16-bit PCs increased 6%.

Japan's PC production & exports

(units in thousands, total/**export**)



Source: Electronics Industry Association of Japan

Europe appears to be the largest market for Japanese manufacturers. They sold 96,000 units there, for a healthy increase of 22%, compared with North America's 26,000 units and modest 2% growth. Although the Asia-Pacific market absorbed only 15,000 units in the first quarter of fiscal 1990, its growth rate reached about 72%.

In fiscal 1989, Japan's PC exports increased 22% and generated $897 million in revenue. However, EIAJ forecast that Japan's PC exports would total $864 million and register a 3.6% decline in the 1990 fiscal year that ends March 31. It also forecasts that Japan's PC exports will continue to drop 4.3% in fiscal 1991.

While Japan's PC manufacturing industry will be able to carry a 11.7% compounded annual growth rate to the end of fiscal 1991, says the EIAJ report, the PC makers will have to sell more and more PCs to the domestic market.

But since there are only 86 PCs for every 1,000 Japanese, compared with 176 units per 1,000 Americans, it seems the Japanese PC makers will not have to worry about saturating their domestic market in the future.

XIONG XIAOGE

SEMICONDUCTORS

Consortia mend fences, open door to IBM

JESSI AND SEMATECH ironed out their differences in December, paving the way for IBM Corp. to officially join the research consortium designed to revive the European microelectronics industry. Jessi is the $4 billion, government- and industry-funded initiative for more than 100 European chip makers, semiconductor equipment manufacturers, and computer and telecommunications end-users.

Jessi invited IBM to join two projects: a deep ultra-violet lithography project for producing 0.3 micron chips and another for preparing gate dielectrics by rapid thermal processing. Later, IBM will probably join more of the 50 projects comprising Jessi.

In return, Jessi will cooperate with Sematech. Jessi set up a project specifically to address collaboration between the two consortia.

Unofficially, IBM was involved in Jessi through its work with Siemens AG on developing a 64-megabit DRAM. Jessi funding contributes to the cost of setting up a production line to make the 64-Mb, and the process technology will be shared with Jessi members. But any product-specific research will be proprietary to IBM and Siemens alone.

Meanwhile, European governments are balking at funding Jessi, whose officials have been urging the European Community to pony up more money for Jessi. Reportedly, the EC has funded only 7% of the 1990 budget instead of the 25% it was slated to kick in.

Ever since N.V. Philips withdrew from Jessi's SRAM research, while remaining in 20 other projects, the Dutch government has halted additional Jessi funding until it evaluates the impact on the Dutch information technology industry. Meanwhile, SGS-Thomson Microelectronics and Siemens AG are taking up the slack in researching basic memory technology as it applies to RAMs and EPROMs.

On another front, IBM announced it is relocating its 120-employee Communications Systems unit headquarters to the London area. The division develops intercomputer networking products and services. Observers say the relocation illustrates IBM's commitment to OSI, the standard heralded in Europe. It is the first time IBM moved a product group outside the United States.

The move coincides with IBM's announcement of 1991 cuts in its European workforce of 108,800. The early retirement provisions are part of IBM's worldwide job-shedding program.

BARBARA BERKMAN in London

SOFTWARE

European demand defies U.S. slump

IF THE DAYS of soaring high-tech sales growth seem gone with the wind, take heart from Europe's unabated hunger for U.S.-made software. Even in a near-recessionary climate, a group of 32 U.S. software developers racked up sales of $228.8 million in the third quarter of last year, 63% more than in the third quarter of 1989, reports the Software Publishers Association (SPA).

That growth follows 48% growth in second-quarter sales. "The European market continues to defy forecasts of a slowdown," says Ken Wasch, executive director of the 720-member Washington-based trade group.

The SPA report, prepared by consultant Arthur Andersen and Co., shows 61.1% third-quarter sales growth for DOS/Windows-based software and 82.7% third-quarter growth in Macintosh-based software. As in the U.S., applications for Microsoft's Windows were a hot item: Windows software sales grew 243% in the third quarter, according to the SPA report. Other companies surveyed for the report include Lotus, Ashton-Tate, WordPerfect, Claris, Aldus, and Borland.

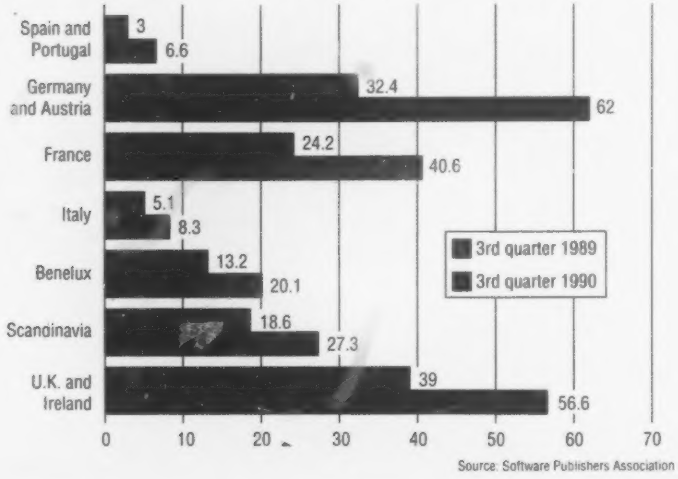
Germany and Austria provided the largest market for the 32 U.S. companies in the third quarter: $62 million. Spain and Portugal posted the highest rate of sales growth for the period: 120%. The SPA estimates that sales of U.S.-developed software products represent nearly 70% of the total software market in European countries.

JOHN PARKER

Europe splurges on U.S. software

Survey of 32 companies shows 63% sales growth

(sales in $ millions)



Source: Software Publishers Association

DIGITAL AUDIO

It is DAT versus DCC in tape-format faceoff

JUST WHEN YOU thought it was safe to go out and buy those DAT players, along comes DCC.

For the acronym-averse, the latter means "digital compact cassette." And just as it seems that digital audio tape (DAT) players were shaking off copyright-protection red tape, the Netherlands' Philips and the U.S.'s Tandy Corp. announced they were co-developing an alternative. DCC, it seems, will be able to play both analog and digital prerecorded tapes. In short, it looks like there will be another format war, much like Betamax versus VHS.

Not all observers see it that way, though. Like the HDTV race, some see it as an East versus West issue; so far only Japanese companies have produced both the hardware and software for DAT. Others see it as a hardware versus software war: DCC consumers won't have to ditch their current collection of analog cassettes, and they will be able to digitally record on DCC.

Either way, most feel that DCC will steal some of DAT's thunder. DCC also gives record companies some breathing room—they won't, at least for a while, have to commit entirely to the DAT format. Philips's subsidiary Polygram and a few other recording studios have already come out in support of DCC. So far, only CBS Records, a subsidiary of Sony Corp., offers pre-recorded DAT tape.

Philips intends to launch DCC sometime in 1992.

"It is really a war of wits, not us versus them," according to Walter Miao, analyst for New York City-based Link Resources. "What it amounts to is: Philips can't catch up in DAT, but it can take it one step further."

Miao also points out that the Japanese—even with the proposed acquisition of MCA Corp. by Matsushita [ELECTRONIC BUSINESS Nov. 26, 1990]—don't control enough of the entertainment software distribution to designate DAT as the new standard. "The recording community today is controlled by the studios, and the studios control 95% of the distribution of prerecorded music." He

SHIPMENTS

A sluggish year ahead for shipments, says NEMA

FLAT AS FAR as the eye can see. That is what the National Electrical Manufacturers Association predicts for electrical products shipments this year. That is not good news for the myriad companies in the high technology field, which is used to double-digit growth rates. "Things look rocky," says Bernard Falk, NEMA's president.

On average, NEMA predicts a mild .02% decline in shipments overall for electrical products; that is a slight improvement from an expected drop of .07% for 1990.

The results from NEMA's study come from a survey, conducted in late 1990, of 300 member companies in nine major industry segments: industrial automation, lighting equipment, electronics, industrial equipment, building equipment, insulating materials, wire and cable, power equipment, and diagnostic imaging and therapy systems. In all, NEMA tracks 65 individual subsectors of the industry. For 1991, 20 of these subsectors expect negative growth this year, 19 will be flat, and the rest will see some positive growth.

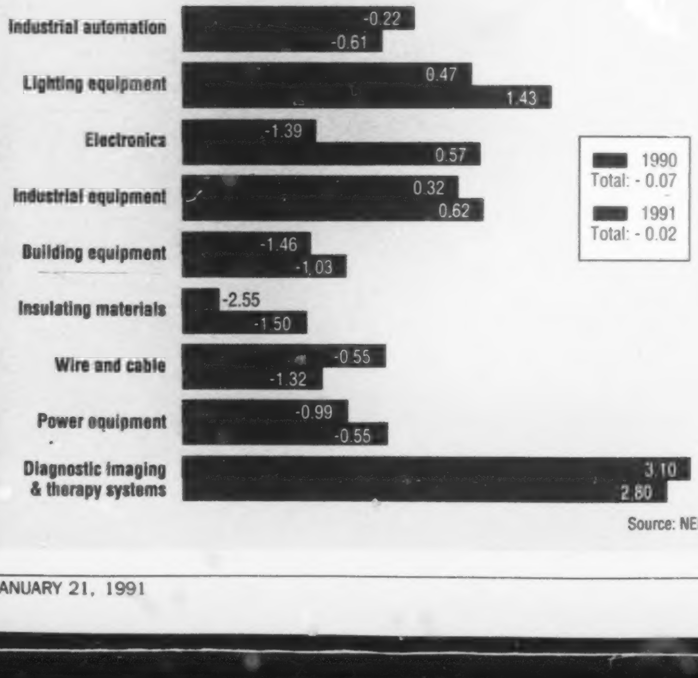
The bright spots for 1991 seem to be largely in emerging technologies. The diagnostic imaging and therapy systems, for example, will average 2.8% growth in shipments, down from 3.1% in 1990. Within this group, medical image archiving and communications equipment will post 20% growth, while lithotripters (devices used to treat kidney stones) will post 50% growth. In the electronics segment, traffic-control systems will post a healthy 5% growth for the year.

The worst-hit segment is expected to be insulating materials—including laminates, resins, tubing, and sleeving—where growth is predicted to be a negative 1.5%, up from a negative 2.6%.

NEMA expects strong U.S. exports in 1991 if foreign economies continue to grow. When the dust settles, exports for 1990 for all nine industry segments should be $2 billion higher than 1989, while imports will have grown only $370 million. ☐

Sluggishness behind, sluggishness ahead

(weighted average of year-end domestic shipments growth in real terms)



Source: NEMA

TRADE

Third-quarter data shows strong exports

U.S. EXPORTS of electronics-based products posted strong growth through the third quarter of 1990 while imports grew only modestly, reports the American Electronics Association. This resulted in a "substantial improvement" in the balance of trade for the industry as a whole.

Altogether, worldwide exports grew to $52.5 billion during the first nine months of 1990, up 15.4% from the same period in 1989. Imports for the first nine months of 1990 increased just 2.7%, to $53.7 billion from $52.3 billion for the same period in 1989. The U.S. trade balance for the first nine months of 1990 was a negative $1.2 billion, down significantly from the $6.9 billion balance for the same period in 1989.

After peaking in 1986 at $13.1 billion, the electronics balance of trade declined steadily to $9.6 billion in 1989. If the pace during the last few months of 1990 is any indication, the annual trade balance for 1990 will show a dramatic improvement. The AEA estimates, in fact, that the U.S. trade balance for all of 1990 will shrink to $1.9 billion. The association's full-year estimates show improvement in trade of telecommunications products and semiconductors, but not in computers or instrumentation products.

According to the AEA, the U.S. has improved its trade balance with all its major trading partners during the nine-month period largely because of a weakening dollar and a sluggish domestic economy. Even the U.S. balance of trade with Japan, which has been hovering around $20 billion annually, shows signs of moderating.

The U.S. increased its exports to Japan by 9.1% for the nine-month period, to $6 billion. During the same period, imports fell by 5.4% to $19.3 billion, for a total trade balance of negative $13.4 billion.

BRUCE C.P. RAYNER

How Silicon Systems turns yen into dollars

Acquisition by Japan's TDK Corp. will finance the California chip maker's entry into higher-growth markets

BY TERI SPRACKLAND

To those who worry that the late 20th century is witnessing the end of America's dominance in electronics, the sale of another U.S. company to the Japanese may be a fate worse than death.

But for Silicon Systems Inc., the 1989 acquisition by Tokyo's TDK Corp., producer of magnetic tape and electronic components, has meant a new lease on life—and the money to hang tough through soft markets. Today, managers at Tustin, Calif.-based SSI are confident that they can grow in the fiercely competitive automotive electronics market while still investing in their core business of providing chips to the modem and disk-drive industries.

The relationship may not sit well with some, but Carmelo J. Santoro, SSI CEO and president, takes a pragmatic view. "The money has to come from somewhere, or we as Americans will totally lose our ability to compete," he says. "SSI is now creating things in America that American dollars couldn't do. I have turned yen into dollars."

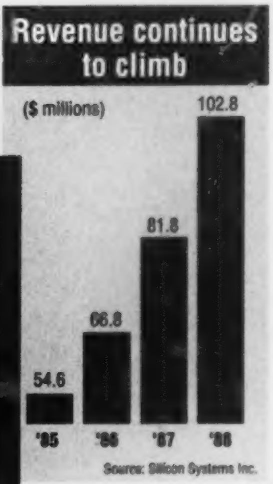
The marriage of the two companies has already paid off with SSI's introduction of a programmable filter IC pegged to hard-disk drives, reportedly the first single-chip device to perform this function. The chip could also be used in LANs, digital transmission equipment, car telephones, and video systems, and will be marketed through TDK's distribution channels.

The long-term payoffs for both companies are much higher. Because of TDK's investment (reportedly $100 million or more in new U.S. production), SSI is now eyeing annual sales of at least $1 billion by the end of the decade, versus last year's $140 million. And thanks to SSI's prowess in mixed ASIC design, the acquisition should serve to beef up TDK's efforts to become a major player in the international semiconductor business. SSI will form the core of TDK's semiconductor strategy. Japanese corporate estimates are that TDK's chip sales will grow by 25% in the next five years. "[SSI] is a nice match for us," says Yutaka Mori, SSI's senior vice president of planning and coordination.

In the past, SSI had relied on a niche strategy of providing highly focused products for specific applications, namely disk drives. In fiscal 1988, disk-drive related chips provided $95.8 million of the company's revenue of $120.8 million; communications chips brought in $21 million. In August 1988, the company had even expanded with the $21 million acquisition of an idled AT&T fab in Santa Cruz, Calif., near major customer Seagate Technology.

But that niche approach eventually fell victim to the volatility of the marketplace. As disk-drive makers' profitability and sales plummeted, their chip suppliers—including SSI—felt the pinch. By mid-1988, the industry was saddled by overcapacity and price-cutting, according to analysts at Dataquest Inc. in San Jose. Disk-drive sales on the volatile spot market had flourished; in fact, Seagate had at one point received more than half of its sales revenue from this channel. The efforts of several key OEMs to produce their own drives also curtailed sales opportunities. If that weren't enough, the industry had to cope with two other factors: too much competition from start-ups funded by lavish quantities of venture capital from the early 1980s and a product transition from the 5.25- to 3.5-inch drives.

The result was that, although the company's 75% share of the market for disk-drive chips was a strength during fiscal 1988, it had become a liability by the next year. During the six years prior to the acquisition, SSI grew at a compounded annual growth rate of 40%. But by late 1988, new orders had plunged by 52%, a 35% decline from


Revenue continues to climb

Source: Silicon Systems Inc.

SSI CEO Santoro: no longer a slave to Wall Street

the same period in the previous year.

The situation worsened during early 1989 when new orders fell by 19% and income dropped 47% compared with a year earlier. In one quarter, SSI's book-to-bill ratio went from 1.0 to 0.4, recalls William Tai, vice president with investment firm Alex. Brown and Sons in San Francisco. "They had good technology and good products, but the disk-drive market sector has historically been subject to great volatility," says Tai.

With equity too low and interest rates too high, says Santoro, it proved impossible to raise the needed capital on the open market. "The driving force in the acquisition was our need for capitalization," he recalls. "We were hopelessly trapped as a small but technically capable company." Now, he says, SSI's debt to TDK is funded at "an embarrassingly low" rate of interest.

Stopping the slide

With its financial problems in check, the company is now able to focus more of its energies on developing sales in the automotive electronics market and appears to have made some progress (including some business from Ford), according to Tom George, vice president of worldwide sales. Pursuing that goal will be a long-term effort, he says, but one that the company can now afford. "We are making some headway, but it is slow going. It can be years from concept to use in the automobile," George notes.

In August, SSI announced an agreement with Integrated Semiconductor Solutions of Santa Clara, Calif., a company specializing in automotive and industrial application ICs and boards, to design and market mixed-signal ICs for automotive sensor-control applications. The designs are to be contributed by Integrated Semiconductor Solutions, with SSI contributing foundry, design tools, and product engineering support. Both companies will market the resulting products.

The automotive electronics markets will grow by about 8% annually through 1995, notes Paul Hansen, president of market research firm Hansen Associates in Goffstown, N.H. And according to Market Intelligence Research Co., the worldwide automotive embedded-control market was $507 million in 1987 and will top $1 billion by 1995. Motorola remains the leader in the North American merchant market for automotive electronics with a 24% share.

SSI can now afford to design quality into its products instead of testing it in

Meanwhile, SSI is also moving into the 9,600-baud modem market, another technology investment that the company could not afford until TDK came along, says George. One target sales area are modems pegged to laptop and notebook computers.

Santoro admits that SSI's shortage of cash before the acquisition had taken a heavy toll in other ways. SSI had always held to its marketing strategy of identifying and fulfilling niche demand for products that could have long production runs. But other factors—including product quality—did not receive the same attention. "We never found the time to improve quality," according to Santoro. "I used to have to say 'no' to a lot of things that we should have done. As a result our quality was mediocre—average at best."

That has changed since TDK and its high product standards entered the picture, he says. Instead of testing for reliability after manufacturing, for example, the company now places a special emphasis on building quality into the design and production processes. During the past year, says

TDK fulfills a long-time goal

Japan's TDK Corp. was founded in 1935 to industrialize ferrite, a Japanese invention, notes Yutaka Mori, SSI's senior vice president of planning and coordination. The materials were pegged to computer memory systems until ferrite memories gave way to semiconductor memories.

Following that switch, TDK tried unsuccessfully to develop its own internal silicon capability. Still determined to break into the memory business, the company tried during the 1970s to form a joint venture with Fairchild Semiconductor, again without success.

With the acquisition of Silicon Systems Inc., however, TDK hopes that its patience will be rewarded. "Our traditional area in passive components has been growing very slowly—7% to 8% a year," says Mori, compared with 15% a year for integrated circuits. SSI's strength in mixed ASIC design is beneficial to TDK's plans for sales in both the United States and Japan. "It will be nice to compete head to head with companies like NEC without dumping money into DRAMs," Mori notes.

Although Mori characterizes SSI as having been fairly successful in marketing its products in Japan through a trading company, direct sales through TDK will undoubtedly increase revenue. "TDK knows the Japanese competition," explains Mori. "Eventually we would like to open a fab in Japan because the demand for our type of ICs is growing very rapidly there."

By late August 1990, quarterly results for TDK showed about a 15% jump in net earnings and sales, to $43.9 million income on $839.9 million in sales, up from $38.2 million on sales of $733.1 million a year earlier. Especially significant was the 33% jump (from $333.3 million to $446.2 million) in sales outside Japan, to which the acquisition of SSI contributed. In that quarter, TDK derived more than two-thirds of its revenue from the electronic materials and components division, in which sales climbed 17% from a year earlier to reach $576 million.

Sales were strong in products such as magnetic heads, chip capacitors, multilayer chip components, inductors, transformers, and ferrite cores. Due in large part to the SSI acquisition, in fact, revenue from electronics parts is growing faster than sales of the company's well-known magnetic tapes, according to a 1989 report by Yamaichi Securities Co. ☐

Santoro, product quality has improved by 100%. The company also has set a goal of achieving a product-return rate of no more than one per million by the year 2000.

Realignment and expansion

The acquisition of SSI by TDK is in many ways similar to that of Materials Research Corp. by Sony Corp. in August 1989. MRC, which developed the key metals for the thin-film coating of semiconductor wafers, also had difficulties acquiring the funds for future product developments from its bankers. As an alternative, the company received access to cash in a cordial acquisition by Sony.

After the TDK acquisition, SSI realigned operations to create seven units with profit-and-loss responsibility that focus on market-specific products. Four product lines—for read/write and servo-preamplifier products, pulse detector/filter products, data recovery products, and controller products—focus on storage technology, the bulk of the company's business. The other units focus on modems, digital transmission, and the automobile market.

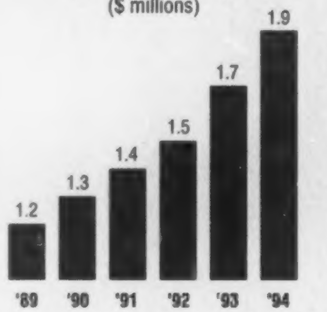
In July, TDK announced plans to invest $100 million to expand production of CMOS and bipolar ICs at both of SSI's California plants to meet demand within SSI's traditional disk-drive and modem markets. In Santa Cruz, 6-inch wafer CMOS equipment on 1.25-micron process is replacing a 4-inch wafer capability on 3-micron process; production at the site is expected to increase by as much as 500%. In all, about 27,000 square feet of Class 1 fab space will be added to the existing 35,000 square feet of Class 100 space. Products will include telecom chips, as well as some automotive chips.

In Tustin, production will increase by about 30% and will eventually include high-speed bipolar ICs, enlarging fab space by 7,000 square feet. The plant now produces 4-inch bipolar and CMOS wafers. Moreover, outside foundry agreements with Oki Electric Industry Co. have been extended. The original agreement called for an exchange of capacity for a license to produce SSI's 1,200-bps modem chip; the new arrangement, however, includes an exchange of SSI's 2,400-bps modem chip for Oki's 8-bit series of microcontrollers.

Yet another move was a technology swap agreement with Philips Components-Signetics of Sunnyvale, Calif. The swap involves technologies used to make ICs for hard-disk drives and includes a bipolar process developed by Signetics.

Autos spell growth for SSI

Total semiconductor market consumption for North American automotive electronics industry ($ millions)



Source: Dataquest Inc.

Changes at SSI also include personnel. Tom George moves into his slot as head of worldwide sales following a stint as vice president of North American sales. Rick Goerner, formerly senior vice president of marketing and sales, was named to a newly created post as senior vice president of business operations overseeing the new business units. Santoro, who was retained as CEO, says that he feels freer to make long-term plans for SSI. In fact, he marvels at the slow, methodical, no-quick-changes style of Japanese management. "I was told I was asking for approval too often," he notes with some bemusement.

Yutaka Mori, senior vice president, calls the SSI acquisition "a nice match" for TDK

Searching for a haven

As survival in the chip business continues to demand ever-higher funds for R&D, more and more independent smaller companies will be forced to find their own solutions to raising needed capital—especially given the currently weak economic environment, contracting venture capital funds, and an uninspired stock market.

For now, at least, SSI management has found its haven in TDK. SSI executives are finally able to devote their attention and energies toward building a billion-dollar company instead of anxiously watching the company's quarterly stock performance. "You almost become addicted to that way of life," says Santoro. "Now I don't have to agonize over my investment. Professionally and personally, I had become a slave to Wall Street." Today, he adds, SSI is much more independent than it ever was as a public company.

But how long SSI maintains its independence remains to be seen. Some observers believe that TDK is treating its new property as an investment rather than a takeover. When questioned on that point, Mori becomes thoughtful. "Frankly, we don't know," he says. "SSI is doing fairly well as an independent operation, so TDK won't intervene unnecessarily."

Still, he continues, everyone recognizes the vast differences between Japanese and American management styles; surprises and misinterpretations are virtually inevitable. "We must always confirm and reconfirm," says Mori. "A couple of small disconnects can cause major divergence."

But for the foreseeable future—five to ten years, according to Mori—TDK's main semiconductor business will be on American soil. "The staff in the United States knows how to do business here," he says. "It is a really interesting experiment which has yet to be proven." ☐

A tough road ahead for Taiwan's PC makers

Taiwan's economy is getting hammered by both the U.S. slowdown and its own problems. PC makers are seeking new paths to profitability

BY XIONG XIAOGE

The year 1990 was a tough one for Taiwan's personal computer manufacturers. Since exports account for more than 90% of the demand for PCs made in Taiwan, the slowdown of U.S. and European economies has begun to hurt the island's high-tech industry. A Taiwanese government official recently warned that the nation will lose 5% of its exports to the United States if America's economic growth falls by 1%.

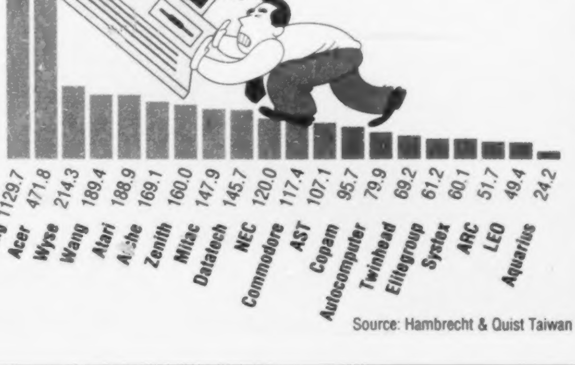
But that is not the only thing worrying Taiwan's PC makers. There are some serious domestic problems too. A shortage of engineers, the appreciation of the Taiwanese dollar, rising wages, and inflation have all hit home, as has the virtual collapse of Taiwan's stock market.

Market Intelligence Center of the Institute of Information Industry, a government-sponsored market research agency, says that in 1989 the total production of Taiwan's PC industry (including peripherals and software) reached $1.39 billion, and the island country exported $1.24 billion worth of PC products. From 1987 to 1989, Taiwan's PC production registered an astonishing 41% compounded annual growth rate. In the uncertain economy during 1990, MIC estimates that the annual growth rate of Taiwan's PC industry increased only about 25%, for a total of $1.77 billion in overall production and $1.56 billion in exports.

In the domestic economy, the new Taiwan dollar has appreciated about 25% over the past two years. Wages in Taiwan have increased between 15% to 20% annually since 1988, while the inflation rate runs three times higher than the government's 5% target. "For PC designers and manufacturing engineers, this year's wage increase jumped 30% to 35%," says C. K. Cheng, vice president of Mitac Research Corp., one of Taiwan's largest PC makers.

Taiwan's PC industry is lacking highly qualified engineers, so many companies have been attracting talented engineers away from competitors by offering inflated salaries.

Top 20 computer companies in Taiwan



Source: Hambrecht & Quist Taiwan

Cheng says that Mitac has lost quite a few talented people to its competitors this year.

On Taiwan's stock market, the Weighted Index dropped from a high of 12,682 in February to a low of 2,500 in early October.

"The stock market's slowdown means Taiwan's PC companies will have to rely more on the cash flow generated by their own operations than on new capital investments," says Ta-lin Hsu, managing general partner of Hambrecht & Quist Asia Pacific and director of Taipei-based Hambrecht & Quist Taiwan.

The increasing wage and inflation rates have further slimmed the industry's already below-average profit margin, which, according to Hsu, runs between 3% to 5% in Taiwan.

Mitac made a nice profit of $9.4 million on $145 million in sales in 1989, or over 5%. But the company's profit margin is projected to drop to below 5% in fiscal 1990, says Cheng.

On the other hand, Acer Group, Taiwan's second largest computer maker, has been hit hard already. Acer originally expected to net $25.5 million in fiscal 1990. In August the figure was projected to fall to $18 million and recently dropped to $10.9 million, mainly because of the narrowing profit margin.

One solution to increasing profit margins is to raise prices, but Taiwanese PC makers have relied heavily on lower prices to compete with such U.S. PC giants as IBM and Compaq Computer Corp. "If you want to maintain the profit margin by raising the price, the customers may turn to Compaq- or IBM-made PCs," says Hambrecht & Quist's Hsu. "It is difficult to change the local PC makers' image from sellers of inexpensive products."

"It does not mean the quality of Taiwanese-made PCs cannot compete with U.S.-made PCs. It is really an issue of brand name recognition," says Hsu, "just as a suit tailored in Paris can sell for a higher price than one of identical quality made somewhere else."

Taiwan's PC manufacturers are adjusting, for starters, by upgrading their products, taking on such new technology as laptop computers, and diversifying their markets.

One of Taiwan's strengths is its quick adaptation to new technologies. The world's first notebook PC was introduced in 1988 when Japan's NEC Corp. announced its Ultralite. Last year, Taiwan witnessed a craze to replace the desktops with laptops and notebook PCs. An MIC report says about 200 Taiwanese PC companies have already started to manufacture portable PCs. But because Taiwan's surface mount technology is still under development, the yield rate of most laptop and notebook PC makers is still below 50%.

"The company with better manufacturing technologies for portable PCs will be in a much stronger position to compete in Taiwan's PC industry," says Mitac's Cheng.

Taiwan's thirst for technology has motivated some PC manufacturers to bring home foreign partners. With about $70 billion in non-gold hard-currency reserves, Taiwan has the world's largest cash hoard, which enables its PC makers to merge with or acquire high-tech companies from foreign countries. By doing so, Taiwanese companies can obtain a higher degree of technological competence and marketing channels.

The Acer Group has been expanding overseas. Its acquisition of Altos Computer Systems Inc. is the largest overseas deal the Taiwan PC industry did last year. Acer paid $94 million to acquire the San Jose-based manufacturer of multiuser systems. "Acer was eager to move upward from a PC manufacturer into a manufacturer of multiuser, multitasking systems, in addition to expanding its marketing channels in the United States," says Hsu.

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"I believe the uncertain world economy is the major challenge to Taiwan PC makers"

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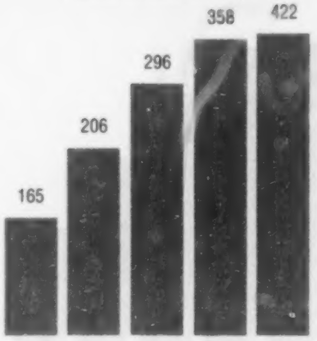
Ta-lin Hsu
Hambrecht & Quist

In addition, the Taiwanese PC manufacturers are making efforts to diversify export markets, and Europe is a major target. According to an MIC report, Taiwan's exports of PCs to Europe topped $672 million in 1989, more than half of the country's total PC exports. MIC estimates Taiwanese PC makers captured a 16.3% share of the total European PC market in 1989.

Taiwan PC production

(units in thousands)



Source: Market Intellegence Center, Institute for Information Industry

"If you look at the revenue generated by each salesperson of any Taiwanese PC company, the figure is always higher in Europe than in other areas," says Mitac's Cheng. According to Cheng, Taiwanese-made PCs are priced 15% to 20% higher in Europe than in the United States because of greater demand. With one major sales office in England and another in Germany, Mitac sells about 40% of its PC products to Europe.

Over the past two years, the growing costs have forced the Taiwanese PC makers to move their manufacturing operations offshore to neighboring Pacific Rim countries where less-expensive labor and land are still available. In 1989, Acer began the construction of its first overseas manufacturing facility in Malaysia. The $20 million plant is scheduled for completion in 1992.

Theoretically, mainland China is an ideal place for Taiwan's cash-rich PC makers to invest. The island is separated by the 100-mile-wide Taiwan Strait from China's Fujian province. The people living on both sides of the strait speak the same language and have the same cultural background. And the average salary of a PC assembly worker in China is less than one-fifteenth of his Taiwanese counterpart's. What's more, the Chinese government has adopted various favorable policies, including a five-year no-tax grace period to attract investment from Taiwan.

At present, Taiwan's PC makers still cannot capitalize on these opportunities because of the Taiwanese government's restrictions, which ban direct investments in the mainland.

Although the Taiwan PC makers have felt the increasing pressure, they have not taken enough action. Hsu estimates that Taiwan PC makers who have invested in Thailand, the Philippines, and other Pacific Rim countries, have spent only between $15 million and $20 million, spanning from 1988 to 1990. ☐

Multibus II stages comeback in communications

In search of markets not already staked out by VMEbus, vendors discover a potential gold mine in applications for telecom and datacom

BY DAVID WEBB

It has been said that all things come to those who wait. For vendors of Multibus II single-board computer bus products, those things appear to be new applications that may well prove to be the architecture's salvation.

Multibus II vendors have had a tough nut to crack since their first products began trickling onto the market in 1986. Intel Corp. spearheaded the second generation of the bus architecture's development effort, but ironing out details for an agreeable standard was a costly process. VMEbus appeared in volume five or six years ago at just about the peak of the Multibus I lifecycle. As Multibus I matured, vendors of the VMEbus architecture products staked out most of what was left of the market. Multibus II vendors were faced with very few market opportunities that VMEbus had not locked up already, since Multibus I users could not migrate to Multibus II.

But new markets may provide Multibus II with the steam it needs to compete with the VMEbus. Although VMEbus appears to have all but locked up the U.S. industrial process-automation market for single-board computers, new and potentially lucrative applications will give Multibus II vendors growth opportunities outside the secured VMEbus market base of data acquisition, minicomputer systems, and military applications. Moreover, the European market appears to be accepting Multibus II over VMEbus in applications that are dominated by VMEbus in the United States—most notably industrial automation.

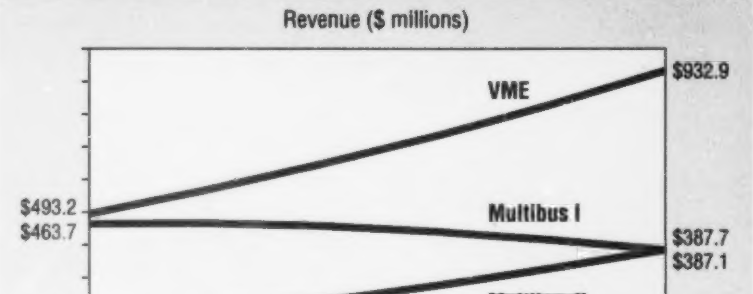
"It seems that Multibus II has come of age in the last year," says Bart Mallio, a bus market research analyst at Natick, Mass.-based Venture Development Corp. "For years it was a technology in search of applications. Finally, it appears there are applications and growth opportunities in areas no one thought of at its conception."

Mallio estimates Multibus II to have a modest 15% share of the industrial process-automation market, which is overwhelmingly dominated by VMEbus. However, the biggest opportunity for Multibus II single-board computer vendors—including Intel, Siemens AG, Mentec Computer Systems Ltd., and Concurrent Technologies Inc.—is the potentially huge telecom and data communications market, for which Mallio and others say the architecture is especially well-suited.

"There is no doubt that communications will drive growth in the Multibus II market," says Mallio, adding that the bus lends itself to multitasking and acting as a communications bridge between systems. Multibus II has more efficient message-passing capabilities than VMEbus, which allows it to send large chunks of data at once and package them for transfer across a network, according to Mallio. Such features are attractive to telecom and datacom companies seeking to convert conventional systems into computer-automated systems.

Mike Richmond, product marketing manager at Intel's Industrial Computer Division in Hillsborough, Ore., agrees with Mallio. "Generally we see [communications applications] as new market share," he says. "No one bus has really penetrated that market." Richmond especially believes that the boom in cellular telephones and networked computer systems will cause Multibus II demand to grow phenomenally within the next three to five years.

VME holds the lead in battle of buses



Source: Venture Development Corp.

While single-board market watchers all agree there is a large market emerging in communications, no one is really sure how large that market is. But estimates from the Multibus Manufacturers Group in Aloha, Ore., appear to support Richmond's claims. MMG predicts that the market for Multibus II products will grow at an impressive 52% compounded annual growth rate through 1995. Len Schulwitz, executive director of MMG, says that Multibus II vendors generated $175 million in worldwide revenue in 1990. At a compounded annual growth rate of 52%, the market would grow to $266 million this year, $404 million in 1992, and $614 million in 1993. If Schulwitz's estimates hold up through 1995, Multibus II vendors could realize revenue totaling $1.4 billion.

But according to Mallio at Venture Development, an independent research firm, the outlook is less bullish. Venture Development estimates a 24% compounded annual growth rate from 1989 to 1994. The firm estimates the market has grown from $130 million in 1989 to $181 million in 1990, and it expects revenue to reach $226 million this year and $331 million by 1993.

The VMEbus market, by comparison, has dwarfed Multibus II to date, and it appears as if it will continue to dominate the single-board systems market for the foreseeable future. The VMEbus International Trade Association (VITA) says the VMEbus market has grown from $600 million in worldwide revenue in 1989 to $700 million for 1990. The association expects that number to continue growing this year to $825 million, followed by steady growth to $930 million in 1992, and to more than $1 billion by the end of 1993.

Venture Development estimates revenue of $566 million in 1990, $645 million in 1991, $734 million in 1992, and $829 in 1993 with a compounded annual growth rate through 1994 of 13.6%.

Aside from Motorola, key VMEbus single-board computer suppliers include Force Computers Inc., SBE Inc., Radstone Technology Inc., and Heurikon Corp. All told, according to Lym Hevle, executive director of VITA, there are about 350 vendors of single-board computer products on the market, the vast majority of which are VMEbus-based.

But Hevle says while Multibus II never really caught on the way VMEbus did, he admits it is growing, despite continued anticipated robust demand for VMEbus products. Surprisingly enough, VMEbus vendors don't really even consider Multibus II a market competitor anymore, much less a threat, says Hevle. "The war, such as it was, is over. We don't really talk about or pay much attention to those guys anymore."

But if the communications market is now wide open, it seems that Multibus has the edge. Intel's Richmond says it is Multibus II's design that is making it attractive not only to the communications market, but to European manufacturers as well.

"It is a layered, disciplined architecture that runs better than VMEbus does within the protocols of computer system networks," Richmond says. Multibus II, according to Richmond, allows communications companies to build upon its Intel 80386-based 32-bit microprocessor platform made possible by new input/output controllers. "[Communications customers] like the clean architecture. It matches the way they think. VMEbus doesn't match the way they think," says Richmond.

For many of the same reasons a second market opportunity for Multibus II vendors—actually a subset of the communications market—is data communications. Major minicomputer systems vendors are also interested in Multibus technology in much the same way that Digital Equipment Corp. is embracing VMEbus for its VAX-based systems.

Intel's Richmond claims that minicomputer manufacturers like Prime Computer Inc., NCR Corp., and Bull HN are all test-driving Multibus II with their system designs, largely because of its bridging capability and ability to handle data in volume. ☐

Too many Futurebuses

Since 1987, computer chip and board manufacturers have been quietly working together to develop a standardized system bus architecture that would unify VMEbus and Multibus proponents and provide a high-performance solution for the 1990s.

However, enthusiasm over the goal of that effort, known as Futurebus Plus, has waned in recent months. Some vendors and analysts are pushing back expectations of Futurebus's 1991 arrival another year, with slow market growth expected through 1995. That pessimism is being fueled by a factionalizing of the development effort. At least 12 versions of Futurebus are vying for standardization. The outlook is bleak for any one of those proposals to gain enough support to become even a de facto standard within the next two or three years.

"The situation is something like that in Orwell's *Animal Farm*," says Pete Yeatman, president of Radstone Technology Corp., Montvale, N.J. "In this case, all versions of Futurebus are supposed to be equal, but some people are pushing their own versions as more equal than others."

The resultant fragmentation of ideas for what would be the Futurebus standard has some vendors turning back to basics.

"[Futurebus] is definitely off to a nebulous start," he says. "There are some people out there who are sort of crying doom for Futurebus, and some of those were the same people who two to three years ago were playing it up."

Ease of migration is a critical issue for users who have invested thousands—and maybe even millions—in one architecture or the other and now want to leverage the older technology while converting to the new.

But the third-party vendors behind Motorola Corp.'s VMEbus, Intel Corp.'s Multibus II, and Digital Equipment Corp.'s Q-bus are each pushing for profiles closest to their own architectures, leaving little hope that anything but a highly specialized and expensive de facto standard—perhaps two—will emerge.

Mallio isn't expecting Futurebus Plus to arrive in force until 1996, and even then his estimates for worldwide revenue from the architecture is relatively modest at $55 million for that year. ☐

CASE vendors look to the past to find their future

Disappointing demand for traditional computer-aided software engineering tools has vendors focusing on software maintenance issues

BY PETER BURROWS

Vendors of computer-aided software engineering (CASE) tools have always faced a fundamental business problem: Their products all but ignored their potential customers' most pressing problem.

That problem is software maintenance, which deals with the need to control, revise, streamline, and add to existing programs. Such efforts account for about 80% of all software-development activity, according to a study by Volpe, Welty & Co., a San Francisco investment bank. But while CASE vendors have successfully automated parts of the software-development process for new programs, few products offer any help to companies struggling to maintain sprawling MIS systems or keep track of complex, evolving technical programs. "If you can use CASE to solve only 20% of your problems, what is so great about it?" asks Ian Smith, an information management specialist with AT&T in East Brunswick, N.J.

Now, after years of disappointing sales, CASE vendors have finally turned to program maintenance as an area in which they can be of immediate and strategic use to customers. Following the lead of a cluster of niche players who pioneered the market in the mid-1990s, mainstream competitors such as Cadre Technologies Inc. of Providence, R.I., and Index Technologies Corp. of Cambridge, Mass., have introduced products to help customers make sense of their existing programs. At the same time, large computer vendors such as Digital Equipment Corp. in Maynard, Mass., Hewlett-Packard Co. in Palo Alto, Texas Instruments Inc. in Austin, and IBM are developing CASE environments that include in-house or third-party software maintenance tools.

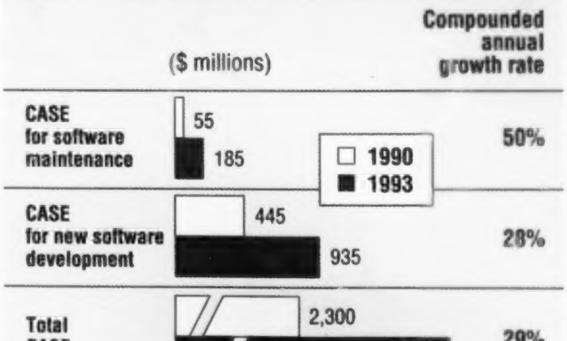
But observers say that the CASE industry has paid a heavy price for its slow reaction to this market opportunity. Less than 3% of all COBOL code—the preferred language of MIS developers—was developed using CASE, according to the Volpe, Welty study. A 1990 survey by CASE vendor CGI Systems Inc. of Pearl River, N.Y., of 25 executives of companies with CASE experience "found tremendous skepticism and an almost universal feeling that CASE is still in its infancy," says Robert Bouton, CGI's vice president of marketing. "The vast majority of executives were unable to provide tangible evidence of any actual benefits."

Suppliers are hoping the new focus on maintenance automation will enable them to overcome this disillusionment with CASE. And while no vendor has yet put together a total solution to the problem, the products now on the market do enable software managers to make some headway. Vendors such as Bachman Information Systems Inc. in Burlington, Mass., Language Technology Inc. and Procase Corp., both in Santa Clara, Calif., and Viasoft Corp. in Phoenix have spent millions to attack specific portions of the problem and now boast they can save 25% or more on total maintenance costs.

This time around, such claims are often more than hype. AT&T's Smith, for example, reports time savings of 25% by using a product from Index Technology to analyze a billing system containing more than a million lines of code. "There has been a lot of yelling by vendors about products that have nothing to do with what we need to accomplish," says Smith. "But the bottom line is that this tool has saved us time. In the end, that is what it is all about."

But just as salvaging a run-down house can be more difficult than building one from scratch, finding solutions for software maintenance problems is in many ways a more daunting task than creating tools for new program development. The required products must work within the customer's existing software-development methodology and must be able to make sense of millions of lines of code that have been thrown together over the years, often by now-departed program-

Software maintenance to outpace CASE



Source: Volpe, Welty & Co.

mers who most likely didn't take the time to document their work. IBM estimates that 47% of the time programmers spend on existing systems is spent trying to understand undocumented or poor-quality code.

"Programmers don't believe in documentation," says Schmuel Halevi, an analyst with Boston-based Technology Research Group. "Programming is closer to poetry than to engineering, so what we need now is some magical tool to find out what the systems designer was originally thinking."

Fortunately for vendors, customers have little choice but to wait for such solutions to arrive. Companies cannot afford to abandon software systems that provide the backbone of their day-to-day operations long enough to tackle the time-consuming job of implementing new systems. Nor can they afford to throw out their investment in existing systems. Rewriting old MIS applications can literally cost millions of dollars. Conventional wisdom states that each line of code costs $25 to develop, and many programs are well over 100,000 lines long.

But companies cannot afford to accept the status quo, either. Software development is taking up an increasing amount of industry's resources. Hewlett-Packard, for example, has gone from a ratio of 70% hardware engineers and 30% software engineers in 1980 to the exact opposite today, the company reports. And maintenance productivity continues to fall as program size and complexity increases, putting a strain on established companies to upgrade their software systems fast enough to remain competitive. One study by DEC indicates that maintenance programmers create only 1 to 2 lines of new code per day versus 10 to 15 lines for new system developers.

Nonetheless, CASE vendors face cultural barriers as they try to sell maintenance-related products. For one, vendors must overcome the reluctance of engineers who have been burned by the hyped-up claims of CASE suppliers in the past. They must also overcome the cowboy mentality of programmers who are not interested in fitting into a structured maintenance methodology and the resistance of systems engineers who are not interested in getting bogged down in code-level analysis. But more important, vendors must deal with customers' lack of understanding of the scope of any effort to automate the maintenance of software systems. "Customers perceive they have a problem and are ready to spend some money," says analyst Vaughan Merlyn of CASE Research Inc. in Bellevue, Wash. "But they are not ready to spend what it takes in terms of training, infrastructure, and new methodologies."

Why automate software maintenance?

Because of the spiralling cost of new software development

Lines of code	Time required	Cost	Typical program
1,000	300 hrs.	$ 10,000	Software utility
10,000	4,000 hrs.	$ 120,000	Simple PC program
100,000	65,000 hrs.	$ 2,000,000	Commercial business application
1,000,000	800,000 hrs.	$25,000,000	Weapons systems or a complete MIS system for a Fortune 500 company

Source: Volpe, Welty & Co.

The three Rs

The software maintenance automation tools on the market fall within three hazily defined groupings:

- Reverse engineering. These tools make sense of existing systems. Some simply restructure the source code, weeding out some of the extra baggage and redundancy in the process. Others decipher the code's basic design and present it in easy-to-read graphical structure charts. This simplifies maintenance by letting engineers do their work at the conceptual level rather than at the code level;
- Reengineering. These tools, typically used in tandem with reverse engineering technology, let systems designers restructure and improve upon well-understood existing systems. Some tools, for example, let engineers translate a program into a more sophisticated computer language or transfer to a superior database;
- Reuse. This technology, now largely limited to theory, would enable engineers to partition existing programs into modular building blocks that could then be used to easily create future programs. "The holy grail," says Dave Dayton, executive vice president with Cadre, "is to be able to pick and choose software modules from a software databook, just as we now do with hardware."

While there is much hand-wringing over how to categorize these products, it is clear that they will be a source of fast growth for CASE vendors. One estimate by Volpe, Welty says that the market for maintenance/reengineering tools will grow from $55 million in 1990 to $185 million in 1993—a compounded annual growth rate of 50%. This exceeds the expected growth rate for CASE as a whole, which is slated for 29% annual growth over that time, from $2.3 billion to $5 billion. Volpe, Welty uses a broad definition for CASE that includes such technologies as knowledge-based expert systems and object-oriented databases.

Vendors share these high hopes. Cadre's Dayton expects his company's reverse engineering tool to account for 20% of company sales within the first year. Index president and COO Fred Luconi says that "reverse engineering is probably going to be just as large as forward engineering in the short term."

Undoubtedly, some vendors will hawk rudimentary reengineering and reverse engineering tools as a gimmick to spur sales of traditional development tools, observers agree. But at least this time around CASE vendors are addressing the right problem. "Rather than try to revolutionize programming, they have decided to join the real world," says TRG's Halevi. ☐

Lead time data indicates rising prices in the future

According to a buyer survey by *Electronics Purchasing*, ELECTRONIC BUSINESS's sister publication, lead time for all electronic components fell to a record low of 4.4 weeks in October. In November, however, component lead times jumped to 5.5 weeks. The lead time for all components should stretch to 6 weeks during 1991.

Similarly, the lead time for active components stretched from 4.8 weeks in October to 6.1 weeks in November. Delivery times for both microprocessors and memory ICs contributed the most to the overall increase in November. Passive component lead times also pushed up in November after falling to their lowest level in the previous month. Passive devices stretched 1 week in November, anchoring in at nearly 5 weeks. Connector and switch lead times slowed nearly 2 weeks.

As lead times inch their way up expect prices to head up as well. Get ready for slightly longer lead times later this year as end-market demand picks up.

Lead time data reveals much more than mere delivery times. The information also can be used to explain pricing, identify whether a shortage is cyclical or irregular, assess relative market strength, bolster negotiating position, and evaluate supplier performance.

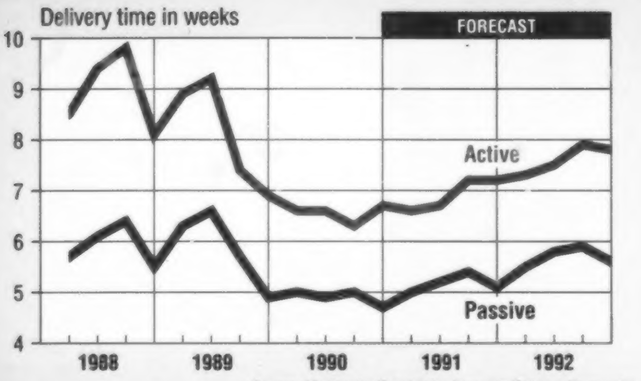
Lead times move in cycles coincident with economic and industrial cyclical patterns and show how much pressure demand is putting on supply. When the economy grows rapidly, for example, demand often outraces supply, lead times stretch, and prices tend to rise. When the economy rises slowly or contracts, on the other hand, supply often surpasses demand, lead times shrink, and prices head down.

A large change in the lead time for a particular component often precedes a change in price. But it is all relative. If a lead time is at the short end of its range and lengthens slightly, the impact on price will be small. If a lead time is at the long range, even a minor change can signal a devastating shortage and disproportionate price inflation.

JULIE HANDELMAN

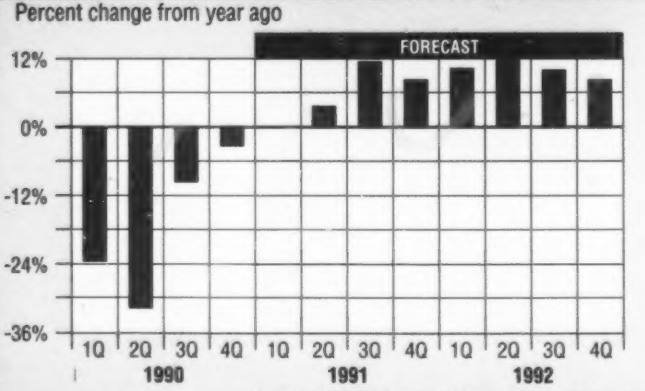
For more information on Cahners Economics' forecasting services, including seminars, newsletters, and database diskettes, contact Dan Buchan at (617) 630-2105, by fax at (617) 630-2100, or write Cahners Economics, 275 Washington St., Newton, MA 02158, U.S.A.

Active and passive component lead times



Source: *Electronics Purchasing*; forecast, Cahners Economics

All-electronic component lead times



Source: *Electronics Purchasing*; forecast, Cahners Economics

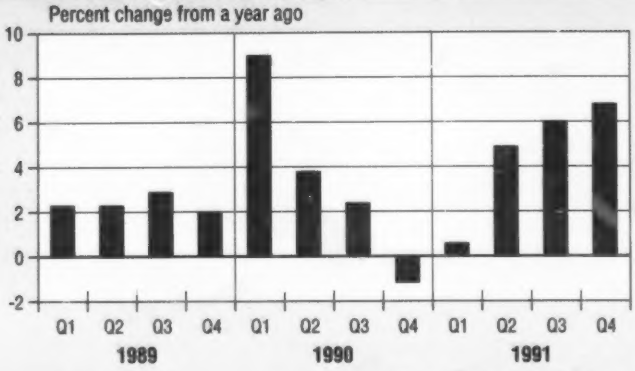
Lead times in detail

Average delivery time in weeks

		FORECAST	
	'90	'91	'92
Active components	6.6	7.0	7.6
Discrete semiconductors	6.3	6.4	6.9
Integrated circuits	5.4	5.7	6.2
Memory ICs	6.3	6.5	7.4
Displays	7.2	7.4	8.1
Microprocessors	7.4	7.7	8.5
Passive components	4.9	5.2	5.7
Connectors	4.8	5.1	5.7
PCBs	5.0	5.2	6.0
Resistors	4.4	4.8	5.5
Switches	5.2	5.3	5.7
Wire and cable	3.3	3.4	3.9
Relays	6.1	6.5	7.1
Capacitors	5.4	5.6	5.9

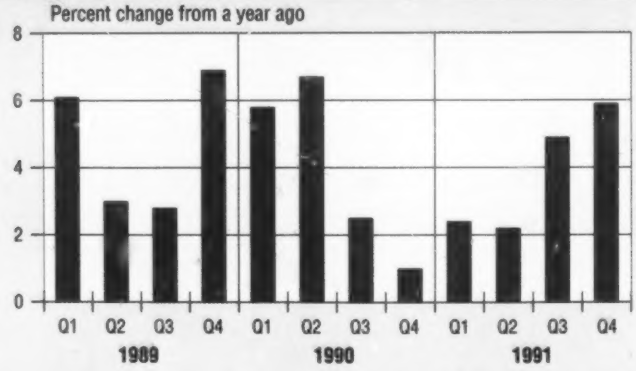
Source: Electronics Purchasing & Cahners Economics

New orders will rise in 1991...



Source: U.S. Dept. of Commerce;
forecast, Cahners Economics

...and shipments will follow



Source: U.S. Dept. of Commerce;
forecast, Cahners Economics

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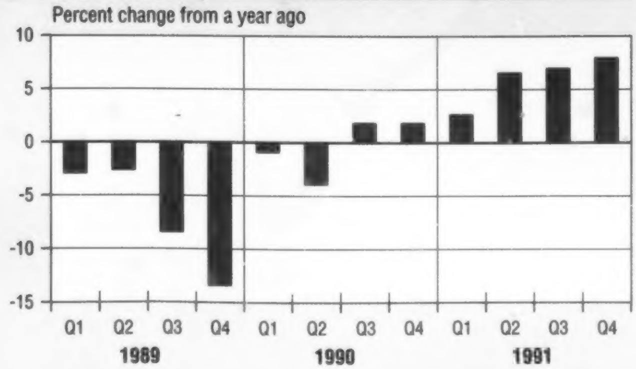

Source: ELECTRONIC BUSINESS;
forecast, Cahners Economics

Instruments and controls expansion ahead

The instruments and controls industry is facing a transitional period as 1991 begins. This year will mark the end of a two-year decline in growth rates, bringing the onset of a two-year expansion. An upturn appeared to start in mid-1990, but the events in the Middle East and low consumer and producer confidence in the second half of the year delayed any recovery.

New orders began 1990 with a surprising first quarter, which came in at 9% above 1989's first quarter. This was followed by more moderate growth of 3.8% in the second quarter. But the third-quarter figure of 2.4% confirmed a delay in a prolonged expansion of the growth rate. The final three-month period of 1990 is expected to show a decline of 1.2% as managers remain wary in an uncertain business climate. And when the picture clears in 1991, new orders will begin to rise and finish the year 4.5% above the total for 1990.

Shipments have shown a similar growth pattern. After leading off 1990 with growth rates of 5.8% and 6.7% in the first two quarters compared with a year ago, growth in shipments dropped to 2.5% in the third quarter. The fourth-quarter growth is expected to slow even further to 1% before heading upward in 1991. The year ahead will end with shipments totaling $55.2 billion, 3.9% above 1990.

Output of instruments and controls will increase in response to higher demand in 1991. Inventory declined slightly in 1990 for the first time since 1987. This will prevent any periods of cutbacks in production before the higher number of new orders push output higher in 1991. An increase of 3% is forecast for the year.

The ELECTRONIC BUSINESS Automatic Test Equipment Sales Index revealed a tough year in 1989 when the index dropped 7.1%. In the third quarter of 1990, the quarterly growth rate posted its first positive number since the fourth quarter of 1988 and will bring the year close to the sales level of 1989. Worldwide sales were expected to total $2.05 billion in 1990, just 0.4% below the previous year's $2.06 billion. Quarterly growth rates will continue to increase throughout 1991, to finish the year with an annual growth rate of 4.6%. This will bring total sales to $2.18 billion in 1991.

JOHN FARRELL

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Electronic Business

FOR MANAGEMENT IN ELECTRONICS, COMPUTER, AND SYSTEMS COMPANIES — WORL

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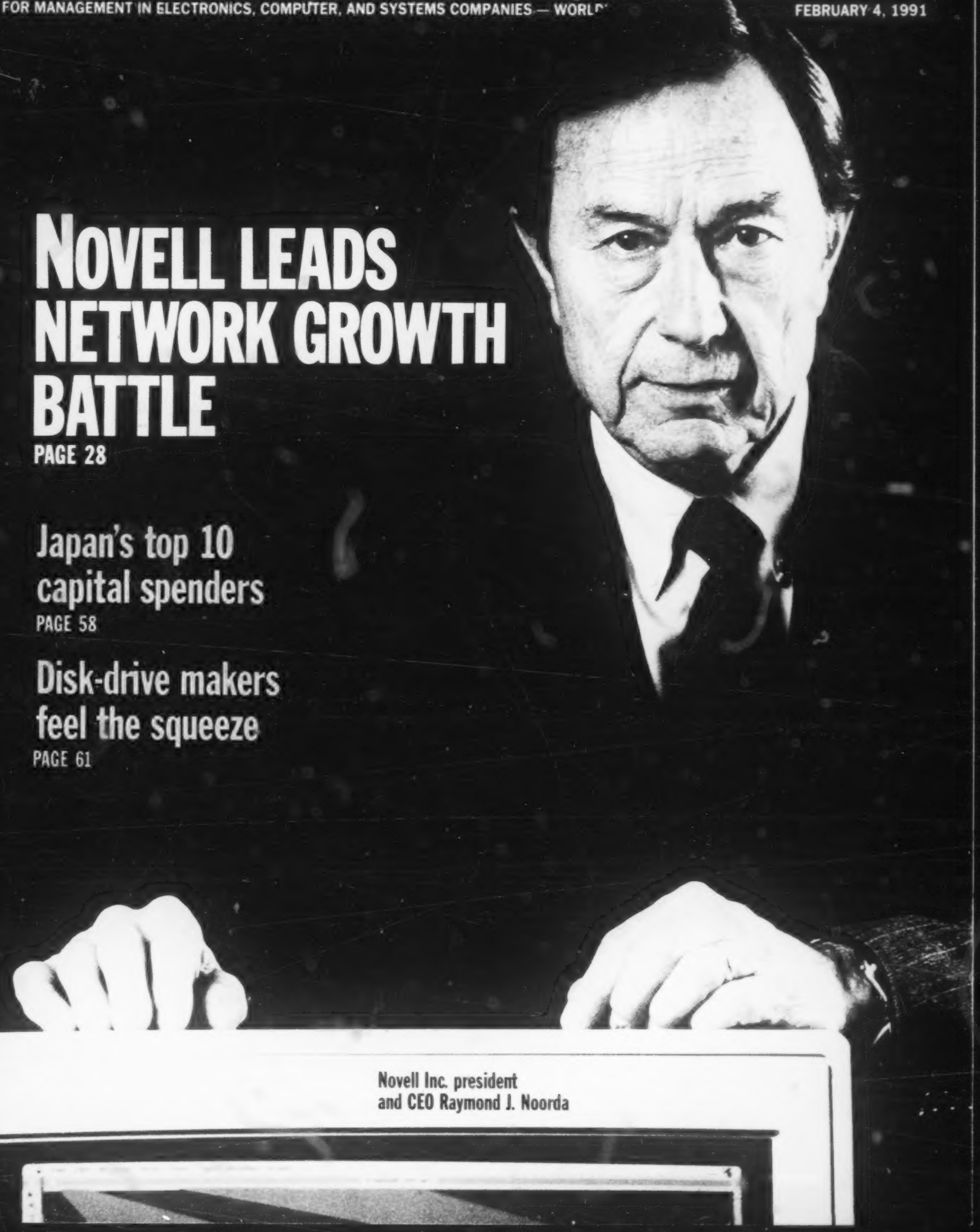

Novell Inc. president
and CEO Raymond J. Noorda

Electronic Business

FOR MANAGEMENT IN ELECTRONICS, COMPUTER, AND SYSTEMS COMPANIES—WORLDWIDE

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FEBRUARY 4, 1991

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COVER STORY/NOVELL

28 Novell sets its sights on corporate networking

Novell Inc. president, CEO, and chairman Ray Noorda's decision to focus his company's development efforts on LAN software has paid off. Versions of Novell's NetWare product line hold about 60% of the network operating system marketplace. Now Novell has embarked on a quest to connect every type of computer and network on the corporate scene

Cover: Paul Fraughton

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A structural mismatch with its competitors may doom U.S. pure-play semiconductor manufacturing, but the U.S. computer industry can survive, says Weitek CEO Arthur J. Collmeyer

COVER STORY/NOVELL

28 Novell sets its sights on corporate networking

Novell built its networking business from the bottom up, targeting small business customers and departmental workgroups for most of the 1980s. Having set PC users free of their data processing departments, Novell is now in the somewhat ironic position of wooing corporate MIS executives. The reason: The thousands of PC LAN islands that have surfaced need to talk to one another, as well as to company mainframes and minicomputers

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31 Aborted Lotus deal all but forgotten

What was to have been the biggest software deal of 1990 never made it off the ground. Citing unequal board representation, Novell's Ray Noorda axed a $1 billion merger with Lotus Development Corp., leaving Lotus chairman Jim Manzi stunned and analysts amazed. Today, though, the bruised egos and recriminations are all but forgotten, Noorda says

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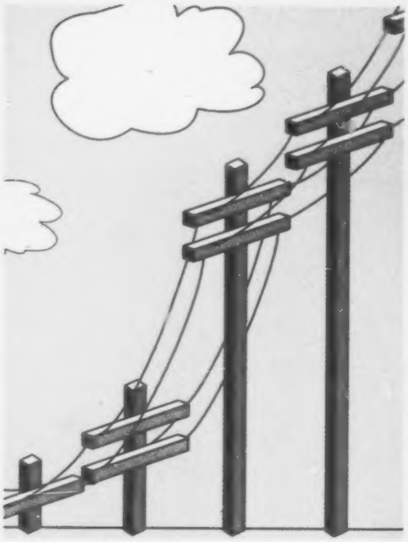
Acquisition by a Japanese conglomerate sounds like the kiss of death to some U.S. executives. But Garrett E. Pierce, president of Materials Research Corp., says life is very good indeed after Sony Corp. acquired the Orangeburg, N.Y.-based vendor of semiconductor production equipment and other thin-film technologies



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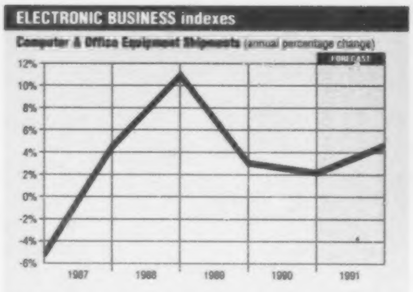

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Japan by the numbers: cutting through the myth

Paula Doe: Getting the latest on Japanese electronics

Japan's success has assumed such mythic proportions that covering its companies, or competing with them, can be intimidating at the outset. But sometimes a little arithmetic helps put the problem in perspective.

Take capital spending. We're used to seeing yen poured like water into critical sectors of the Japanese electronics industry. But now, while capital spending booms in the rest of the Japanese economy, corporate reports show Japan's electronics companies are closing the tap; they too must adjust to the rising cost of capital and the slowing economy.

Where did we get this information? From contributing editor Paula Doe, our Seattle-based *sensei* on the finances of Japan's electronics industry. Her story on Japanese capital spending is one of many insightful reports Paula has filed.

Japanese manufacturing and market-research companies pour out a ton of helpful statistics every year. Unfortunately for U.S. executives, a relatively small portion of the data is published in English, and disclosure requirements are more relaxed in Japan. You have to know where to look and who to ask.

That doesn't stop Paula. After spending her high school years in Japan with her family, she undertook graduate studies in Japanese literature at the University of Wisconsin and in 1980 wrote a book on the subject. Luckily for ELECTRONIC BUSINESS, Paula decided that Japanese high-tech business would be a more interesting field for her research and writing skills.

Certainly, understanding how Japanese business works is of critical interest to U.S. companies. CEO Arthur Collmeyer, in his commentary in this issue, explains how the shift to VLSI technology has put pressure on the semiconductor industry to boost capital expenditures on wafer fabrication. That pressure, says Collmeyer, favors the vertically integrated Japanese computer company and virtually dooms the U.S. pure-play chip maker. But U.S. executives have learned a painful lesson or two, and many of them are taking steps to shield themselves.

Paula Doe agrees there have been positive changes. Americans' perceptions about Japan have become much more sophisticated, she says, and there's a much deeper understanding at all levels of management. Nevertheless, she warns, "there's still a tendency to be overconfident. We tend to think we won't have problems in software or large-computer systems."

Beware that overconfidence. Remember the Japanese proverb: "If you understand everything, you must be misinformed."

JOHN PARKER, section editor

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BPA ABP

HDTV

Zenith lends credibility to dream of digital HDTV

WHEN THE Berlin Wall came down, you knew that democracy was likely to become a reality in Eastern Europe. That same kind of feeling—on a different scale—happened when Zenith and AT&T announced an all-digital HDTV system December 17.

Ever since New York-based General Instruments Corp. slipped a last-minute proposal before the Federal Communications Commission in June, there has been plenty of hype swirling around the possibility of a national, all-digital HDTV system. But while visions of vastly improved picture quality and computer-like televisions danced in industry-watchers' heads, the overriding mood regarding such systems was one of skepticism. How was it possible to compress data-intensive digital signals into the 6-megahertz bandwidth required by federal regulations? It wasn't clear that such compression could even be accomplished for the less-powerful 30-MHz analog signals proposed in analog-based systems.

Zenith's yuletide entry validates these hopes in a way previous proposals from General Instruments and a consortium of the David Sarnoff Research Laboratories, NBC, and the U.S. subsidiaries of Philips and Thomson could not. The Glenview, Ill.-based company has been widely considered the front-runner with its existing, semidigital Spectrum Compatible transmission system. It has been a voice of technological conservatism—even as competitors determined to cash in on the multibillion-dollar promise of HDTV hurled claims and counterclaims. "Before it would not have been smart, economical, or demonstrable to stick their neck out by announcing a digital system," says analyst James I. Magid, a senior adviser with Needham & Co. "But now they really have something to show."

Technical reactions to the proposal have been positive. The system would offer higher resolution than competing proposals, and it meets FCC "simulcast" requirements to make the signals fit into the "fallow" channels that separate the ones on your conventional television. The proposal came after technical breakthroughs by Zenith, which developed a digital filtering system that prevents cross-interference between existing NTSC channels and the proposed digital transmissions; by AT&T's Bell Labs, which developed a new video-compression algorithm; and by AT&T Microelectronics, which made the digital signal processors to execute that algorithm.

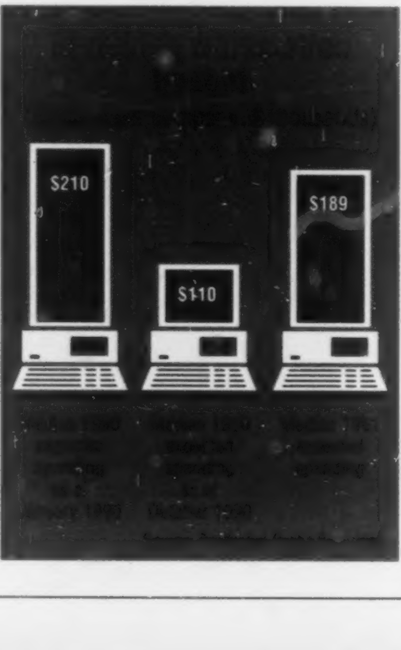
The system, which will replace the spectrum-compatible system previously proposed by Zenith, will be tested in October by the Advanced Television Testing Center in Alexandria, Va. The FCC plans to make a final decision in 1993.

PETER BURROWS

WORKSTATIONS

Workstation demand exceeds cash supply

WITH THE PRICES of workstations falling, this might seem like the time to stock up on these big-ticket computers. But users are bowing to economic pressure and cutting their workstation spending, says Prudential-Bache Securities' latest survey of the U.S. workstation market.



The survey gathered 400 responses from users of equipment from Sun Microsystems, IBM, Hewlett-Packard, Digital Equipment, and other vendors. Here is what the responses indicated:

- As economic reality kicked in during 1990, buyers used price cuts to reduce their overall spending rather than to buy more workstations—an unusual trend in the computer industry. The result was a sharp drop in estimated spending. The pattern could well be repeated this year. While mailed responses indicated plans to increase workstation spending, a follow-up telephone survey showed two-thirds of the respondents expected flat or decreased spending in 1991;
- In addition to price/performance, users are looking hard at compatibility with their installed base of equipment. This helps Sun, still the market leader, but DEC and IBM appear to have gained user loyalties since the last survey;
- The support and delivery problems that bothered Sun users in the last survey are still bothering them, despite some improvements;
- Workstation buyers are making an effort to buy open operating systems, even if they still use mostly proprietary systems now;
- At least in the technical arena, workstations will increasingly be used to replace traditional minicomputers.

JOHN PARKER

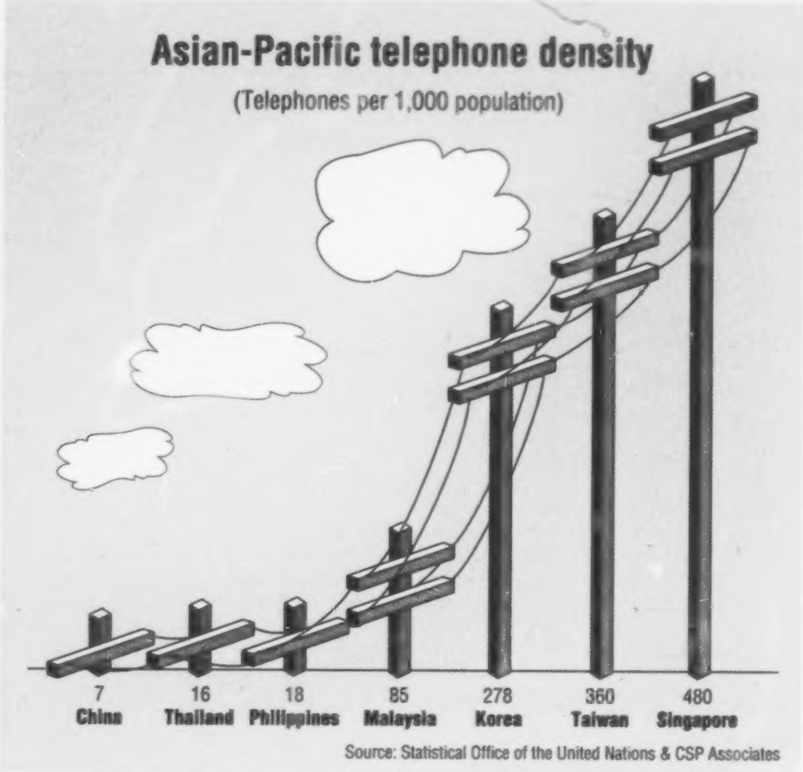
ASIA

Asian-Pacific telecom ringing up growth

AS ASIAN-PACIFIC countries strive to catch up with advanced world standards, U.S. companies can expect to tap the region's growing demand for telecommunications equipment.

"The populous Asian-Pacific region cherishes lots of opportunities for the U.S. telecommunication equipment companies," says Wei An, an industrial analyst at CSP Associates, a consulting firm in Cambridge, Mass. The region is quickly becoming

BUSINESS TRENDS



Asian-Pacific telephone density

(Telephones per 1,000 population)

Source: Statistical Office of the United Nations & CSP Associates

the world's second-largest telephone network, trailing only the United States, says An. He estimates the region's investment in telecommunications will reach $100 billion over the next five years.

Asian-Pacific telephone networks are expanding at an annual rate of 6.7%, leading Europe's 4.4% and North America's 2.8%. The region's share of the global telecommunications equipment market will rise to 31% by 1992, from 25% in 1988, according to recent figures.

Singapore may now possess the most advanced telecommunications systems in Asia after two decades of government-sponsored development. The telephone density of the country reached 480 per 1,000 residents by 1989, while the United States has 760 telephones for every 1,000 residents.

A major driving force behind the quick development of telecommunications networks in Asia is consistently strong government funding. As of 1989, the rate of Singapore's spending for information technology stood the highest in Asia—$13.30 of each $1,000 spent. In this tiny nation, the telecommunications system is operated by Singapore Telecom, a government-owned monopoly. Over the past five years, Singapore Telecom has invested a total of $1.7 billion for telecommunications development. It has also approved another $2.1 billion through 1992.

The value of the telecommunications equipment market in Singapore alone, as An estimates it, will reach $625 million by 1995 from $427.7 million in 1990. Switching equipment, transmission equipment, and data communications are the three major areas of government spending.

To accommodate its fast economic development, the Taiwan government has invested about 1.05% of its gross national product to develop its public telecommunications network and services over the past decade. In 1989, Taiwan's telecommunications network growth ranked ninth in the world.

With its non-gold hard-currency reserve steady at about the $70 billion level, the cash-rich island is spending aggressively on updating its telecommunications technology. In 1989, Hughes Network Systems Inc. won a $7.4 million order from Taiwan's Long Distance Telecommunications Administration to provide a data, voice, and video satellite communications network.

Meanwhile, Taiwan's National Science Council is now carrying on a five-year (1990 to 1995) satellite system development project, which will eventually enable Taiwan to build and launch a 440-pound satellite. The price tag of this project is $364 million, or roughly 3.8% of Taiwan's GNP, a figure similar to Japan's spending on telecommunications. According to CSP's An, this project will be undertaken by subcontracting and technology transfer and will involve 67 research institutes and manufacturers in Taiwan and about a dozen foreign manufacturers, including TRW, Unisys, GE, and Motorola.

XIONG XIAOGE

MARKETING

Compaq hopes to serve an ace in Europe

THE BIGGEST prize paid in tennis history, $2 million, went to U.S. Open champion Pete Sampras, compliments of Compaq Computer Corp. and the Compaq Grand Slam Cup Tournament.

Compaq spent millions to sponsor the Grand Slam Cup in an attempt to market the Compaq name in Europe. "At some time we needed to diversify beyond print. As we grew larger and more financially sound, TV made sense. We felt we needed to do more with brand awareness," explains Eckhard Pfeiffer, Munich-based president of Compaq Europe and International.

Compaq committed to a five-year contract to sponsor the first annual Grand Slam Cup Tournament. For its massive investment Pfeiffer says Compaq got "hundreds and hundreds of hours of transmission" into 85 countries, including the Eastern European market where Compaq will be making a special play.

One Compaq employee spent most of the six-day tournament in a control room pressing a little button that made Compaq's name flicker on the TV screen when the scores were broadcast.

Compaq developed a database for

the Grand Slam that included vital statistics on the game, points, profiles, and performance of the players, updated instantly. The press and tournament attendees had access to 100 desktops, laptop, and notebook personal computers supported by the Compaq SystemPro.

Some Grand Slam players also tapped into the database to check their performance stats between matches. Not Ivan Lendl, though. He was spotted playing the tennis simulation computer game Compaq also provided.

BARBARA BERKMAN in London

FORECASTS

The outlook is up for electronics growth

RECESSIONARY fears will take the edge off the next business expansion cycle, but the electronics industry still can look forward this year to 4.2% growth in shipments—a little better than last year's growth, according to Cahners Economics 1991 *Economic Outlook*.

Cahners's economists forecast 6.1% growth in new orders for electronic components, a 6.6% increase in semiconductor sales, and a 4.5% increase in shipments of computers. In the electronic instruments and controls sector, shipments are forecast to rise 3.9% above 1990 levels, with the automatic test equipment market recovering from two tough years to post a 6.1% sales increase.

Defense budget cuts will take their expected toll on military electronics sales, forecast to fall 1.3% this year. For consumer electronics, the Cahners outlook is for flat growth in sales of conventional equipment but an increase for technologically advanced equipment for home theater systems.

The 57-page 1991 *Economic Outlook* tracks trends in the financial and international markets and in more than 30 industrial and service sectors of the U.S. economy. Readers can obtain copies for $11, the cost of shipping and handling. Write: Cahners Economics, 275 Washington St., Newton, MA 02158; or telephone (617) 964-3030.

JOHN PARKER

TRADE

SII's first fruits hard to swallow

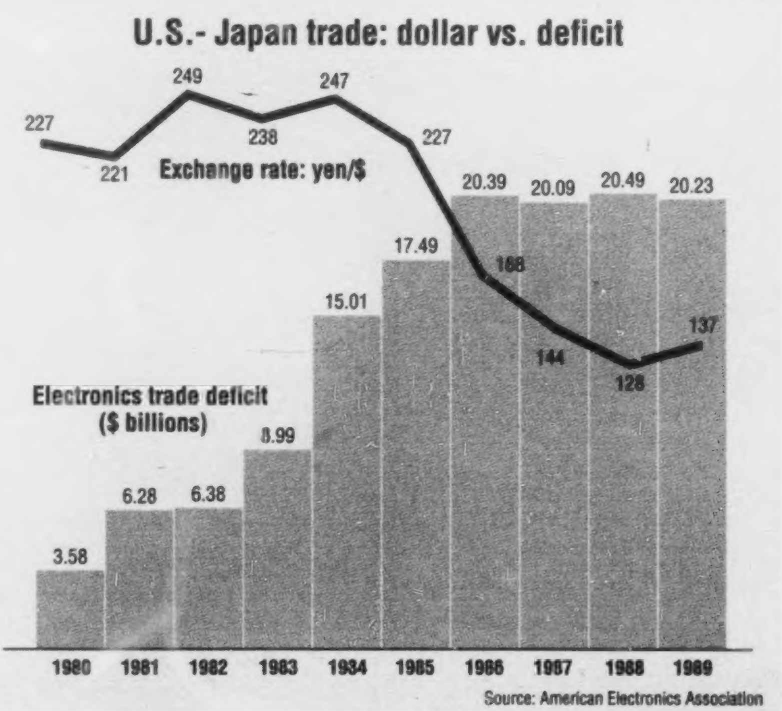
SII PROGRESS REPORT: In its first response to last year's agreement on the Strategic Impediments Initiative, the Japan Fair Trade Commission has released for U.S. consumption its proposed guidelines for regulating unfair trade practices in sole-import distribution contracts. "The fact we have draft guidelines is terrific progress," says William Krist, vice president of international trade affairs for the American Electronics Association. "A year ago, they would have just put the guidelines into effect."

So much for the good news. The Washington-based AEA says the guidelines themselves are seriously flawed because the proposed regulations apply only to foreign companies seeking distributors to the Japanese market. In fact, the requirement that foreign companies—and only foreign companies—register sole-distributor agreements with the fair-trade commission as public documents gives Japanese companies an edge by forcing exporters to "tell the competition what you are doing," says Krist.

As part of their SII agenda, U.S. trade officials have been nudging Japan to strengthen its antitrust policy as a way of offsetting the intimidating power of the huge Japanese trading and manufacturing alliances. The registration of distribution agreements could help, but only if it applies to domestic as well as foreign companies, says trade consultant Orit Frankl in Washington. "We feel this is something that is going to further inhibit access to the Japanese market; it is not progress," she says.

Guidelines on other SII issues, including import clearance and patent pendency, are expected from Japan in the next few months. Meanwhile, the United States is seeing an improvement in its electronic balance of trade with Japan. The AEA estimates that the U.S.-Japan electronic trade deficit fell 10% in 1990, from $20.2 billion in 1989 to $18.2 billion, thanks largely to a surge in third-quarter exports by U.S. companies.

But the AEA warns the respite will be brief. Although recent weakening of the dollar makes U.S. exports attractive short-term, the industry group says that historically the trade deficit has expanded independently


U.S.- Japan trade: dollar vs. deficit

Source: American Electronics Association of the yen-dollar exchange rate.

"Japanese companies have not increased their prices to align them with a stronger yen, particularly in areas, such as VCRs and integrated circuits, that are the subject of fierce global competition," says the AEA.

JOHN PARKER

TELECOM

British Telecom, IBM ponder alliance

U.K.-BASED British Telecommunications plc and IBM may informally collaborate to offer data-communications services to large multinational corporations.

For IBM, any alliance with BT would give improved access to BT's British customers. Neither IBM nor BT would discuss the plan, but it is understood that BT would manage IBM's internal system and IBM would provide the software. The goal is to offer one-stop shopping for communications and computer services.

For BT, a link with IBM would wed Big Blue's massive internal communications system with BT Tymnet, the British company's international data network company.

Observers concluded that IBM's relocation of its communications division to London in January is closely linked with the discussion with BT. Publicly, IBM stated only that it is "constantly in contact" in discussions with a number of companies.

The cooperation would be an informal one, thereby skirting European antitrust regulations. In Britain, recent moves to deregulate the data-communications market pave the way for the IBM-BT talks. But elsewhere in Europe, state-owned public phone authorities won't be so quick to allow competition.

BARBARA BERKMAN in London

CONNECTORS

Aviation, automotive sales help out

THE U.S. connector industry is facing another slow-growth to no-growth year. For U.S. manufacturers, there are some bright spots overseas; as in the past, European and Asian markets are expected to exceed U.S. growth rates.

But even within the United States, the savvy marketer will note pockets of growth. Sales into the commercial aircraft and the automotive markets show healthier growth.

BARBARA JORGENSEN

The connector point-of-sale forecast

Market	1991 sales ($ millions)	Change from 1990 (percentage)
Automotive	375.7	7.1
Electrical equipment	405.1	3.5
Electronic equipment	7,314.6	-0.2
Computer equipment	2,841.8	1.0
Telecom/datacom	1,169.0	4.0
Government/military	1,042.9	-8.4
Commercial aircraft	193.3	6.5
Industrial electronics	203.8	1.5
Test & measurement	422.4	0.0
Consumer electronics	106.9	1.5
Medical	155.1	4.3
	Total: $ 8.1 billion	**Average: 0.3%**

Source: Fleck International Inc.

SOFTWARE

Using software to catch software pirates

ILLEGAL COPYING of software results in annual losses of about $4 billion worldwide and $1.5 billion in the United States. But the Washington, D.C.-based Software Publishers Association believes a combination of litigation, corporate auditing, and employee education is beginning to turn the tide on software piracy.

"There is a lot of parked software on hard disks that users don't even know is there," says SPA executive director Kenneth Wasch. To help find such programs, the SPA distributes a floppy-disk-based program, SPAudit, that can identify almost 700 of the most popular programs on the market. By running the SPAudit disk on its PCs, a corporation can produce a printout of all the software—legally obtained or otherwise—residing on the machines.

Since it received funding for litigation from 11 of its largest members in 1988, the SPA has initiated 60 lawsuits against corporate abusers, according to Wasch. The SPA has also conducted about 40 audits at companies to determine if employees' PCs hold illegal software.

In the pursuit of eliminating piracy, Wasch says large companies tend to have better procedures in place to prevent illegal copying than smaller businesses. Among the SPA's major allies in the piracy battle are MIS managers who are sensitive to the problem, he says, but notes that these managers must sometimes deal with CEOs and CFOs who are more concerned with saving money than with eliminating copying.

The SPA also gets help from former or current disgruntled corporate employees. As many as 90% of its tips about illegal software copying come from such people, says Wasch.

As part of its anti-piracy program, the SPA encourages companies to post signs warning against copying, to orient employees about the problem, and to conduct regular PC-disk audits. "Perhaps the best thing a company can do, though," says Wasch, "is to allocate enough money for buying software to meet the needs of all its hardware users."

DWIGHT B. DAVIS in Seattle

Japan logs a downturn in electronics spending

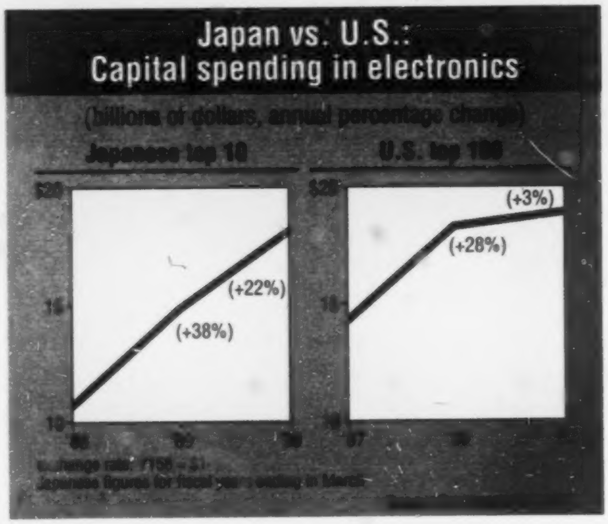
Top companies seem more cautious than in the past. Still, investments far outpace those by U.S. companies

BY PAULA DOE

The growth rate of capital spending by Japan's electronics industry has tapered off noticeably. By most accounts growth will continue to slow as Japanese companies adjust to the rising cost of capital, a slowdown in the global semiconductor market, and a dismal economic outlook (at least for much of this year) in the U.S. and many European nations.

Given these conditions and generally sluggish demand in most key electronics markets, the slowdown in capital spending doesn't come as a complete surprise. But many analysts predict that Japanese electronics companies are just beginning to pull back on their capital outlays. Total expenditures by Japan's top 10 electronics companies climbed by about 22% during the fiscal year that ended March 1990, a sharp drop from the 38% increase posted during the previous fiscal year. The top 10 predict they'll average only about 7% investment in Japan during the current fiscal year.

But spending during the current fiscal year is unlikely to rise by more than 10%, according to a *Nihon Keizai Shimbun* survey of large publicly listed electrical and electronics companies. That's optimistic compared to Japan's Economic Planning Agency, which predicts that spending across the sector will climb by as little as 3%. Mitsubishi Electric Corp. actually cut its total capital spending for the year ending March 1990 and expects to trim domestic investment even more during the year ending March 1991.


Japan vs. U.S.:
Capital spending in electronics

Those figures contrast sharply with Japanese industry as a whole. Only food, textiles, and paper and pulp show growth as slow or slower. Total spending throughout the nation's manufacturing sector is expected to grow by an average of 16%, but could grow more than twice as much in some industries—shipbuilding could actually increase 39%, for instance—according to Japan's Economic Planning Agency.

Outside electronics, the overall strategy appears to be to use Japanese companies' huge reserves of cash, accumulated from years of cheap capital and high profits, to build new automated plants for producing higher value-added products while using as little of the nation's costly and scarce labor as possible.

Despite the flattening spending levels by Japanese electronics companies, however, those producers still spend far more than U.S. companies; while IBM tops the list of capital spenders, in fact, the next seven are all Japanese. Investment in plant and equipment by Japan's 10 largest electronics companies reached a whopping $18.1 billion during the last fiscal year—nearly as much as the $18.9 billion spent by the top *100* U.S. companies combined in 1989. Capital spending by those American companies rose by a mere 3% in 1989, despite a 20% drop in the dollar value of Japanese investment caused by the weakening of the yen. The top 10 U.S. companies increased investment only 3.5%.

More important than how much a company spends is how its spending stacks up to that of the competition. Japanese semiconductor makers whose top managements committed to spend more than their competitors have gained market share, provided that middle management spent the money with at least average effectiveness and maintained a sound product strategy and effective production technology, argues Goro Kumagai, analyst at Nomura Securities Co. Ltd. in Tokyo. Those who didn't keep up, lost out.

Among leading Japanese chip makers, Toshiba Corp. and Mitsubishi's semiconductor operations spent more aggressively than their top domestic competitors, according to Nomura Securities. They also appear to have spent more efficiently, increasing their market shares by 2% and 1%, respectively. Hitachi Ltd. not only spent less than average, it got fewer results from each dollar invested; the company's market share dropped nearly 6 percentage points. NEC Corp. spent the least but it spent it more effectively than most, so it managed to limit its loss of market share to 3%.

Why is Japan cutting back on its spending in the electronics sector? One reason is that there seem to be few compelling reasons to maintain the feverish investment pace of the past. There is far less cutthroat competition among the big Japanese semiconductor companies than there once was, for example, now that these companies so totally dominate some markets and prices are essentially propped up by U.S. government rules.

But another reason may be that producers have reached the limits of what even they can afford, now that capital in Japan is no longer so cheap. Although the investment needed to produce each new generation of memory is expected to approximately double, prices will remain limited by the low cost of preceding chip generations. Indeed, the cost of keeping up with leading-edge semiconductor production technology has become so high that some companies are wondering how much longer they can remain in the ever-more-expensive game.

Spending more to gain global market share

Company	Change in semiconductor market share 1983-1990	Semiconductor investment/ semiconductor output 1983-1989	Increase in output per dollar invested 1983-1989
Toshiba	+2.3%	19.6%	.67
Mitsubishi	+1.0%	19.1%	.67
Fujitsu	+0.8%	25.9%	.49
NEC	-3.0%	14.9%	.63
Hitachi	-5.8%	16.9%	.40
Average		18.6%	.57

Notes: All figures are for fiscal years ending in March. Market share figures are based on share of semiconductor production of Japan's top 10 producers. Effectiveness of investment is figured as the increase in value of semiconductor production from March 1984 to March 1991 as a function of capital spending on semiconductors from 1984 through March 1990.

Source: The Nomura Securities Co. Ltd.

The major Japanese electronics producers don't plan to increase their rate of semiconductor investments at all this year. Those companies plowed an average of 24% of semiconductor revenue back into new semiconductor plant and equipment for the fiscal year ending March 1990, and spent nearly 25% of their total capital budgets on semiconductors. By contrast, capital investment among the 11 U.S. companies on the ELECTRONIC BUSINESS list of top capital spenders that sell primarily semiconductors averages 17% of total revenue.

Changing patterns

One intriguing consequence of these changing investment patterns is that some observers speculate that at least a few of the Japanese companies may decide to withdraw from chip production altogether. ☐

Japan's top 10 capital spenders

Growth slows, especially in semiconductors

Rank	Company	Capital expenditures ($ millions)	Percentage change 1990/1989	Projected change 1991/1990	Capital expenditures as a % of revenue ($ millions)	Semiconductor capital expenditures ($ millions)	Percentage change 1990/1989	Projected change 1991/1990	Semiconductor capital expenditures as a % of semiconductor production
1	**Hitachi**	$4,166	24%	1%	9%	$601	36%	0%	18%
2	**Matsushita**	2,245	9%	60%	6%	456[3]	38%	1%	28%
3	**NEC**	2,176	20%	-7%	10%	570	29%	0%	13%
4	**Sony**	2,049	50%	8%	11%	380	33%	17%	43%
5	**Toshiba**	2,047	21%	7%	8%	601	6%	0%	14%
6	**Fujitsu**	1,904	18%	0%	12%	700	126%	-1%	27%
7	**Mitsubishi**	1,415	-2%	-10%	8%	399[4]	37%	5%	19%
8	**Sharp**	738	45%	8%	9%	285	50%	0%	25%
9	**Canon**[1]	679	29%	NA	8%	NA	NA	NA	NA
10	**Sanyo**[2]	670	57%	-5%	8%	342	0%	-26%	28%
	Total	$18,089	22%	4%		$4,334	35%	0%	
	Average		27%	7%	9%		39%	0%	24%

All figures for fiscal year ended March 1990 except for:

1. Canon fiscal year ended December 1989
2. Sanyo fiscal year ended November 1989
3. At semiconductor subsidiary Matsushita Denshi Kogyo
4. Semiconductor figures for parent company only

NA = not available
U.S. $ = 158 Yen

Source: Company reports. Projected spending for year ended March 1991 from Nikkei Sangyo Shimbun survey. Semiconductor figures from Nomura Securities Co. Ltd.

Compact gigabyte devices squeeze out larger models

High performance, small size of 5.25-inch drives spur OEMs to replace 8-inch units in new system designs

BY DAVID WEBB

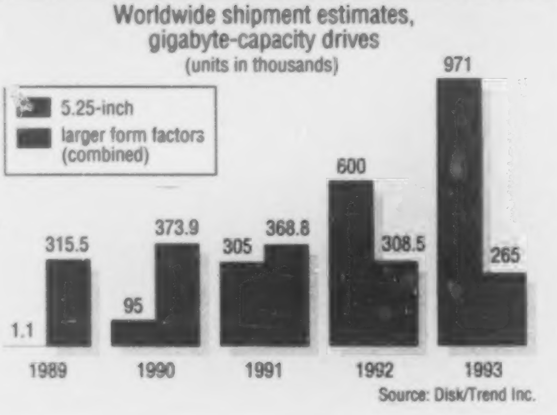
The arrival of volume shipments of high-performance 5.25-inch disk drives with gigabyte capacities signals the beginning of the end for larger form factor drives as a significant product class in the OEM marketplace. Vendors of 5.25-inch drives are overtaking the performance advantages of the larger form factor drives and are aggressively competing with relatively high-margin pricing, low power consumption, and comparable capacities in a much smaller package.

Gigabyte disk-drive market players include Seagate Technology Inc., Micropolis Corp., Maxtor Corp., Hewlett-Packard Co., Fujitsu America Inc., Hitachi America Ltd., and NEC Corp. IBM and Digital Equipment Corp., both big-volume manufacturers of large form factor disks, have had little success penetrating the OEM market beyond their captive consumption. All of these companies are targeting high-end desktop systems, technical workstations, network storage and file servers, minicomputers, and even mainframes and superminis.

Seagate is the market share leader in the 5.25-inch gigabyte-capacity market thanks to its 1988 acquisition of Control Data Corp.'s Imprimis disk-drive unit; Micropolis commands second place. The rest of the pack is considerably farther behind, with Hewlett-Packard, Hitachi, and Maxtor fighting for third place with small-volume shares.

"The leaders are clearly Seagate and Micropolis," says analyst Crawford Del Prete at International Data Corp. in Framingham, Mass. "Micropolis is especially aggressive. They have not only announced some impressive products, but they have demonstrated the ability to ship them in volume." IDC estimates 1990 worldwide shipments of gigabyte-capacity 5.25-inch drives at nearly 80,000 units, with Seagate garnering 48%, Micropolis 30%, Hewlett-Packard 14%, and Hitachi 4% of that volume.

The rise of the 5.25-inch drive



Source: Disk/Trend Inc.

Maxtor, the dominant OEM supplier of 760-megabyte drives, fell behind in the delivery of its Panther series of 1.2-, 1.5-, and 1.7-gigabyte 5.25-inch drives because of manufacturing problems. Ron Lesti, Maxtor's director of new product marketing, says that the product (which was announced in 1989) is now plugged into the company's high-volume manufacturing facility in Singapore and that the company is shipping "thousands" of them.

The world market for disk drives of all form factors with capacities exceeding 1 gigabyte has grown from $8.7 billion in 1989 to about $10.4 billion last year, estimates Disk/Trend Inc., a Mountain View, Calif. storage market research firm. Revenue will hit $11.6 billion this year, remain flat in 1992, then jump to $12.4 billion in 1993, according to the company. Total worldwide revenue for all disk drives reached $25.7 billion in 1990, with gigabyte-capacity drives accounting for more than one-third of the total drive market.

Commercialization of 5.25-inch gigabyte-capacity drives began in 1989; the devices have since become the unit volume leader among all form factors of gigabyte-class drives. Disk/Trend says 1,100 5.25-inch drives were shipped worldwide in 1989, 95,300 were shipped last year, and 305,000 will be shipped this year. Revenue generated from those shipments started at $2.5 million in 1989, grew to $938.5 million last year, and is expected to top $2.5 billion this year. Disk/Trend expects the 5.25-inch gigabyte-capacity market to grow to about $6.4 billion by 1993.

By comparison, Disk/Trend says 317,000 8-inch and larger disk drives were shipped in 1989, 373,900 were shipped last year, and just under 370,000 are expected to be shipped in 1991, revealing the first overall decline of the class. The firm expects 8-inch shipments by themselves to peak next year with the latest generation of 2.5-gigabyte-capacity products.

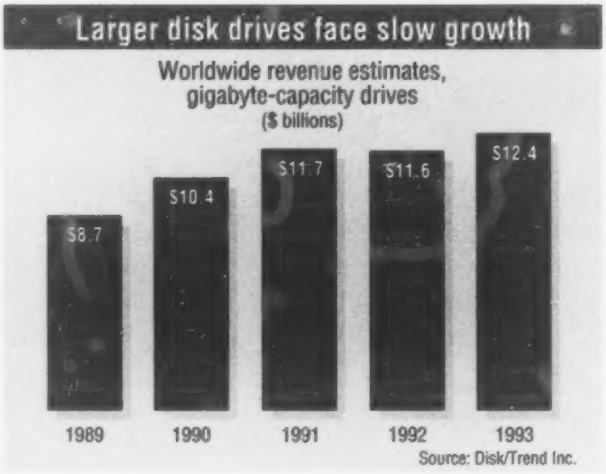
"There is at least one more product

life cycle left for 8-inch," says Dennis Hill, director of product planning for Fujitsu America Inc.'s Computer Products Group. "[But] it looks as if unit volumes of 8-inch drives are holding level—they aren't growing as we look ahead."

Considered far and away the largest market opportunity for gigabyte-5.25-inch vendors is the so-called 760-megabyte upgrade market, which consists largely of high-end desktop and network server system vendors such as Sun Microsystems Inc., Digital, Hewlett-Packard's Apollo workstation unit, and—at certain times—IBM. Since 1.2-gigabyte-class drives were the first to appear on the market, they have seized the vast majority of this segment, largely because many of these system vendors are targeting applications with insatiable appetites for online storage and have taken what they can get.

"We see tremendous upgrade possibilities in the gigabyte-plus market," says Micropolis's senior vice president Chet Baffa, who thinks a major stumbling block for vendors is user mistrust of 5.25-inch products. "They were not the most reliable things in the world a short time ago, but that has changed."

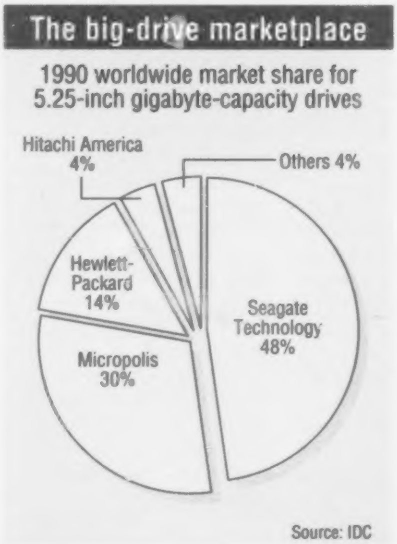
Rudy Thibodeau, director of marketing at Seagate's Twin Cities, Minn., operations, says the 760-megabyte upgrade market benefits from something older generations of 5.25-inch disk drives didn't—the widespread emergence of the small-computer systems interface (SCSI) among small form factor storage peripherals. Not only are OEMs picking up gigabyte-capacity drives for new system designs, but they have already begun to use them to convert existing systems originally available with 760s. "SCSI makes it easy to pick the next capacity point," according to Thibodeau, explaining that the system integration and design-in process is simplified by SCSI's "intelligent" on-board controller design. SCSI's ease of integration, however, means the OEM system design-in cycles will shrink from what was once 3 years to less than 18 months in most cases.


Larger disk drives face slow growth

Source: Disk/Trend Inc.

An issue that may cloud the 5.25-inch market centers around the viability of demand for 1.6-gigabyte products. Not only have they missed a number of lucrative OEM design-ins garnered by 1.2-gigabyte vendors, but at least one vendor is shipping 2-gigabyte drives in volume. System vendors wanting to upgrade from 760-class drives to gigabyte-class drives can now choose between 1.2-, 1.6-, and 2-gigabyte capacities, with cost-per-megabyte ratios improving with higher grades of capacity and availability.

Some OEM vendors see the 1.2-gigabyte class as an interim solution in the move from 760-megabyte to 1.6 gigabytes. "From a technical standpoint, 1.6 has suffered some problems resulting from the development of new design platforms by other vendors," according to Steve Knab, Hitachi's manager of marketing and business planning in Brisbane, Calif. Hitachi sidestepped those problems by extending its 760-megabyte and 1.2-gigabyte technologies to 1.6 gigabytes, rather than starting from scratch as Maxtor and Seagate did. Micropolis was the only vendor to announce a 2-gigabyte 5.25-inch product by year's end. Others (namely Maxtor, Seagate, Hewlett-Packard, and Fujitsu) are expected to join the market this year.


The big-drive marketplace

Source: IDC

Confined market

The 8-inch replacement market is largely confined to those segments in which 8-inch is being used in fileserver, technical workstation, and minicomputer applications—systems in which the performance capabilities of 5.25-inch drives match or nearly match system performance. That market includes the spectrum of form factors, from 8-inch to 9-, 9.5-, 10-, and 14-inch drives.

The replacement market for 8-inch and larger disk drives is complicated by technological issues primarily involving drive-to-system interface architectures. The installed base of large drives consists largely of SMD (storage module device)-interface products, which are device-level and non-intelligent; that is, they require a controller that is removed from the drive and resides within the existing system.

The latest version of SCSI, known as SCSI-2, is approaching performance capabilities of SMD, which has been that interface's key attraction for workstation, minicomputer, and mainframe makers who need the fastest disk performance possible. Disk-drive vendors, including those who market both 5.25-inch and large form factor drives, all agree that SCSI developments indicate the architecture will soon reach parity with SMD in performance and eventually beat it.

"By and large, for 5.25 it is a SCSI world," says Micropolis's Baffa, "and it will continue to be, well into the gigabyte capacities." ☐

Factory management systems bring planning to the plant floor

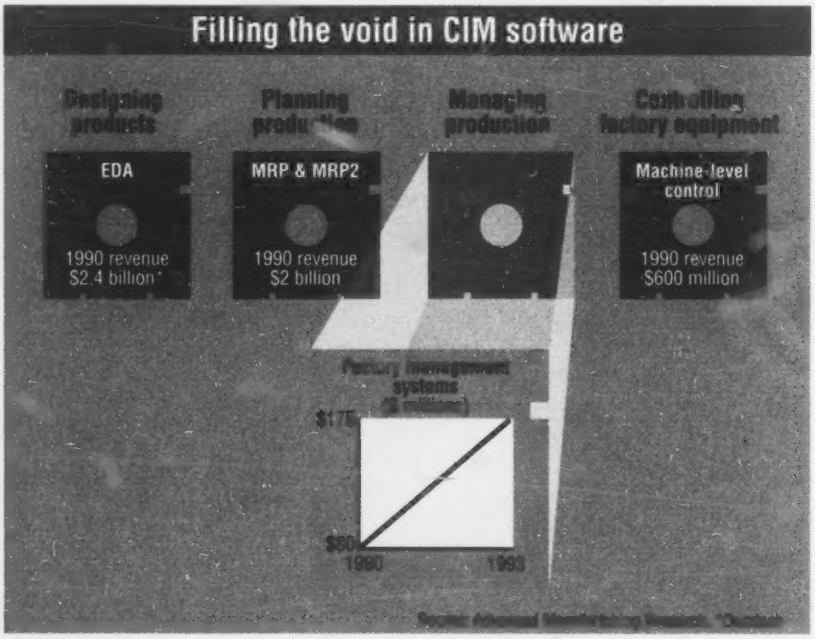
Systems that give managers up-to-the-minute control over manufacturing are rapidly gaining acceptance

BY PETER BURROWS

No amount of executive posturing can guarantee that corporate goals such as quality and time-to-market will be met unless those goals are somehow embedded within the manufacturing process itself. "We have all been beaten up with terms like total quality and employee involvement," says consultant Gerry Cahill, a partner with Ernst & Young. "But what managers really need to know is 'how do I enforce those concepts on the shop floor?'"

Vendors of factory management systems say they have the answer, and a growing complement of customers and industry experts agree. These packages let plant supervisors observe and control many elements of the production line in real time, providing a solution to what had been a conspicuous void in traditional computer-integrated manufacturing, or CIM. Production planners have been aided by MRP (material requirements planning) and the more comprehensive MRP2 (manufacturing resources planning) packages for decades. Equipment operators have had cell-control software. But factory supervisors were largely left to their own devices to manage the complexities of rapidly changing production processes. "You either had a grizzled old veteran who did it on an ad hoc basis, or you didn't do it at all," says Eric Keller, CIM program director with the Gartner Group in Stamford, Conn.

The products in this market still lack uniformity and address varying subsets of manufacturing problems. The products even go by several different names, including "shop-floor control systems" and "manufacturing execution systems." But one thing is clear: The market for plantwide factory management software is growing faster than most manufacturing-related businesses. While the market currently stands at only $75 million, it should grow about 30% a year through 1993, says Bruce Richardson, a vice president with Cambridge, Mass.-based Advanced Manufacturing Research. "It will be one of the few hotspots in CIM in the 1990s," he says. By comparison, Richardson expects the $2 billion-plus MRP market to grow by only 10-15% per year during the early 1990s.


Filling the void in CIM software

Source: Advanced Manufacturing Research; *Dataquest

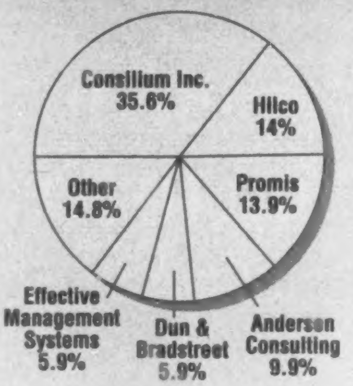
Electronic companies are leading the way in adopting these technologies, especially "bleeding edge" semiconductor companies that must grab every chance to improve manufacturing processes to compete with foreign competition. "We have improved our yield by whole percentage points," brags Steve Nettles, CAM software manager with Advanced Micro Devices Inc. in Austin. AMD has implemented a system in all of its U.S.-based wafer fabs and sorting facilities and is now extending it to offshore test and assembly plants.

An eye on manufacturing

Such success stories are widespread among the core of early adopters, many of whom have been tinkering with homemade factory management programs since the early 1980s. That is because these programs represent the first commercial attempt to automate the minutiae of manufacturing. "MRP systems tell you what you need to do a job, but then they just throw that bucket of materials onto

Factory management system software vendors come of age

(Total market = $101 million)



Source: Advanced Manufacturing Research

the shop floor," says Jonathan Golovin, chairman and founder of Consilium Inc. in Mountain View, Calif., the overall market leader. "It just creates a mess for manufacturing supervisors. They don't need to know what the factory will look like in two weeks. They need to know what it will look like in two minutes."

Factory management systems provide that information by tracking work-in-process, equipment and personnel availability, stockroom inventories, and specific customer requirements. Armed with this data, supervisors can more efficiently route materials and allocate resources, giving them the flexibility to alter production plans when last-minute orders, equipment problems, or other hangups occur.

Customers also also report quality improvements from the use of factory management systems. Because they are distributed throughout the factory, many of these systems are used as repositories for statistical process control data. Others use them to ensure that jobs are done correctly by flashing easy-to-follow instructions on monitors at each station.

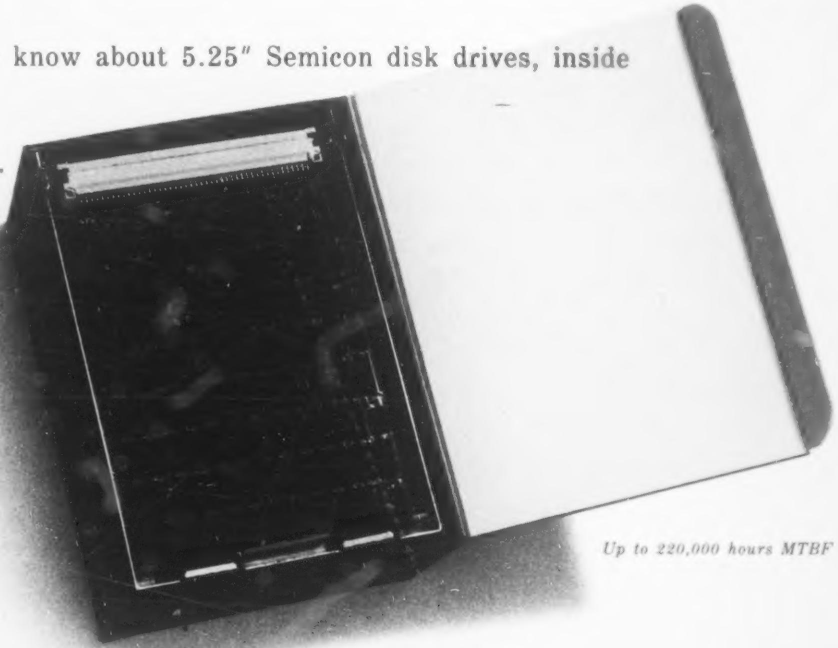
But the greatest and most challenging virtue of factory management systems is that they force users to take a new look at their jobs. "It makes you consider the entire process rather than just your own part of it," says Boaz Yardeni, CIM systems manager for Talla-Com Industries Inc., a Tallahassee, Fla.-based manufacturer of military radios.

But these systems have many downsides. Implementation often takes more than a year, and the systems are expensive. Although software prices are falling —a new product from Consilium starts at $30,000, with older packages costing at least twice that—associated hardware and service costs can put the total price for commercial systems in the $500,000 range. All told, Richardson says that fewer than 2,000 systems have been sold to date.

Such high costs lead to long payback periods, so it isn't easy to justify these systems using traditional cost-accounting methods, says Ed Tomlinson, director of marketing for Toronto-based Promis Systems Corp. "But we find our customers rarely throw our systems out, no matter how old," he says. "You can always make improvements in areas like quality, cost-reduction, or training."

As with many emerging technologies, the greatest obstacles to adoption are cultural. "The biggest problem is get-

All you need to know about 5.25" Semicon disk drives, inside



C&C
Computers and Communications

It's nice to know that NEC disk drives have the most advanced technical features. And it's reassuring that they're consistently available, and with a DOA rate of less than 1%,and up to 220,000 hours MTBF rate that they're reliable.

ting people to understand what these systems can do for them," says Talla-Com's Yardeni. "Most manufacturing people don't consider it their job to report to a computer or look at a screen. You have to find ways to let the system support people rather than hinder them."

Observers say that vendors are on the right track in addressing these problems. Systems integrators such as Andersen Consulting in Chicago, Cimflex Teknowledge in Pittsburgh, and Dun & Bradstreet Software in Atlanta have commercialized technologies they used to sell as custom systems for millions of dollars. Others are moving to modular architectures that enable customers to start slowly and work their way up to comprehensive plantwide systems.

The upshot, vendors say, is that factory management systems are not just for high-volume manufacturers willing to spend millions to realize tiny process improvements. "One of our problems is that people don't realize they can afford this stuff," says George Pacienza, director of marketing for Cimflex Teknowledge. "That's where the hardware vendors come in."

Indeed, computer companies such as Digital Equipment Corp. in Maynard, Mass., Hewlett-Packard Co. in Palo Alto, Calif., and IBM have identified factory management systems as a good way to boost hardware sales. DEC (which controls about 43% share of the factory floor computing market, according to Advanced Manufacturing Research) has signed six software vendors in its attempt to maintain hold on the production floor. IBM has bought the exclusive rights to a system developed by Incode Corp. of Reston, Va., called POMS (Process Operations Management System) and will begin selling the product under its own label later this year.

As a result, the factory management industry is starting to coalesce into a legitimate industry. Once dominated by financially starved, sub-$10 million vendors with highly specialized products, some competitors show convincing signs of survivability. Companies including Consilium, Dun & Bradstreet Software, and Promis have established themselves overseas and forged relationships with the hardware vendors and systems integrators they depend on for survival. And survivability leads to customer confidence, which leads to larger deals. "We are getting fewer simple software package sales and more ambitious projects in the $2 million to $3 million range," says Tomlinson.

"I think we are about to see some companies become dominant players," says AMR's Richardson. Favorites include Consilium, which claims 25 of the world's top 50 electronics companies among its clientele, as well as Promis and Dun & Bradstreet Software. With the technology accepted in principle, vendors of factory management systems must now stave off competition from MRP vendors, hardware vendors, and each other. As with the paper-laden manufacturing managers they are trying to serve, Richardson says "the primary danger [for these vendors] is clutter." ☐

and out.

But all you really need to know is that they're made by NEC, a 24-billion-dollar company, and the fourth largest manufacturer of disk drives in the world. For more information, call 1-800-NEC-INFO.

NEC

BUSINESS BAROMETER

FORECASTS FOR ELECTRONICS, COMPUTERS, AND SYSTEMS

Computer makers see meager growth

During 1990, computer and office equipment manufacturers managed to eke out some minor growth as they struggled with weak business investment, shrinking margins, and a shift toward distributed computing. Third-quarter 1990 shipments dropped 1.4% from the year earlier period, but once all the data is tabulated for 1990, we expect shipments to have inched up about 2% for the year to $71.1 billion.

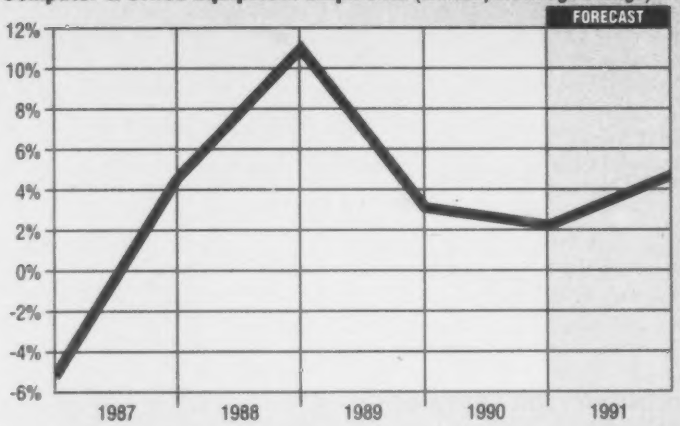
The computer industry can expect one to two more quarters of meager shipments growth before the recovery starts in earnest. Except for a year-over-year decline in August 1990, new orders had been on the upswing and that will feed into increased shipments of 4.5% in 1991. Because bookings began to outrace billings, furthermore, backlogs expanded. This reversed a downward trend in backlogs that started in 1984 and offers the industry a larger safety margin. The turnaround in demand will reflect renewed business investment and healthy increases in exports.

In some respects, computer makers may have stolen some growth away from 1991 by offering steep price concessions in 1990. According to the most recent Datamation/Cowen & Co. Mini/Microcomputer survey, respondents received an average percent-off-list-price of 16.8% for minicomputers, 19.4% for workstations, and 29.7% for mini-super computers.

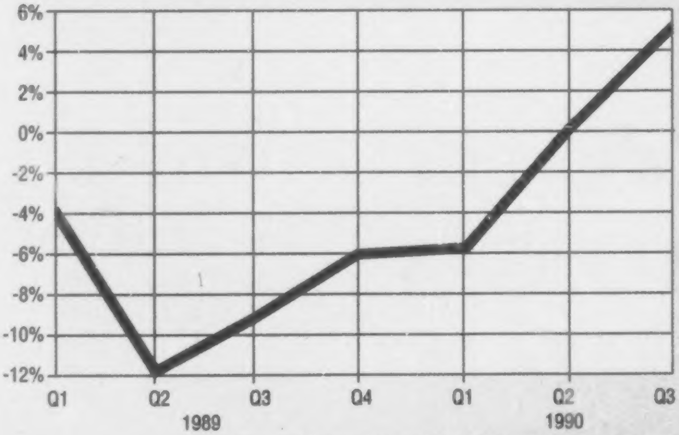
MADELINE FRANCHI

ELECTRONIC BUSINESS indexes

Computer & Office Equipment Shipments (annual percentage change)



Revenue (percentage change from year ago)



Data source: U.S. Commerce Department; Forecasts: Cahners Economics

Computer market database

Latest quarter: 3rd quarter 1990	Latest quarter	Previous quarter	Change	Year ago	Change	Next year	Change
Industrial production (SA, 1987=100, qtr. total)	153.1	149.6	2.34%	139.4	9.83%	169.9	10.97%
Shipments (SA, $ millions, qtr. total)	$ 17,587	$ 17,837	-1.40%	$ 17,688	-0.57%	$ 18,753	6.63%
New orders (SA, $ millions, qtr. total)	$ 18,520	$ 17,598	5.24%	$ 17,959	3.12%	$ 19,197	3.66%
Unfilled orders (SA, $ millions, qtr. total)	$ 13,147	$ 12,214	7.64%	$ 12,477	5.37%	$ 13,383	1.80%
Inventory-to-shipments (SA, end of qtr.)	2.06	1.98	—	2.07	—	2.07	—
All employees (thousands, end of qtr.)	441.0	447.4	-1.43%	460.2	-4.17%	428.1	-2.93%
Production workers (thousands, end of qtr.)	139.0	141.4	-1.70%	146.5	-5.12%	136.4	-1.87%
Business purchases (SAAR, $ billions, qtr. total)	$ 39.64	$ 40.28	-1.59%	$ 41.16	-3.69%	$ 41.34	4.29%
Business purchases (SAAR, 1982 $ billions)	$ 124.27	$ 125.11	-0.67%	$ 119.62	3.89%	$ 136.40	9.76%

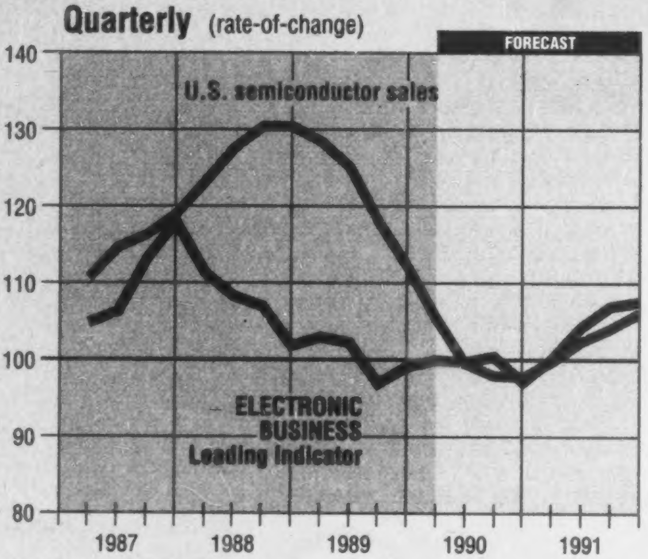
SA = seasonally adjusted; SAAR = seasonally adjusted annualized rate; all other data is not seasonally adjusted

Data sources: Federal Reserve Board, U.S. Bureau of the Census and U.S. Bureau of Labor Statistics
All data for SIC 357, except industrial production, SIC 357-9. Forecasts: Cahners Economics

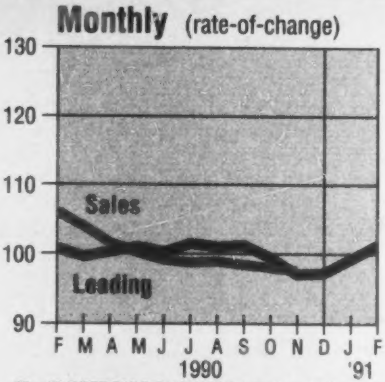
BUSINESS BAROMETER

FORECASTS FOR ELECTRONICS, COMPUTERS, AND SYSTEMS

ELECTRONIC BUSINESS Leading Indicator



To obtain your complimentary copy of a 12-page background paper on the ELECTRONIC BUSINESS Leading Indicator, please contact Linda Spiller at Cahners Publishing Company, 275 Washington St., Newton, MA 02158-1630, USA; telephone (617) 558-4397; fax (617) 558-4402.



The ELECTRONIC BUSINESS Leading Indicator again refused to show an upturn with the latest data. In November, the EBLI fell 2.4 points to 96.9 from 99.3 in October. Whereas the main contributor to the stagnant EBLI in the prior three months was the sinking semiconductor stock price index, recent data revealed declines for four of the six EBLI components. The two exceptions were contracts and orders for plant and equipment, and the stock price index which, after a four month dive, climbed 2.9 points in November. The evidence of a slowdown is more convincing and has led to a revised forecast with a peak of 108.6 pushed to October 1991.

Source: Cahners Economics

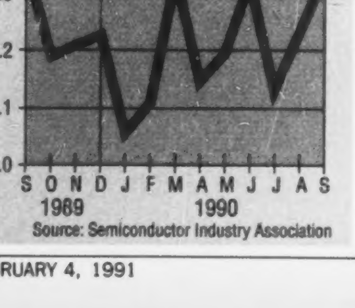
Electronics industry indicators this month

	Latest month	Previous month	Year ago	1989 average
ELECTRONIC BUSINESS Leading Indicator (rate-of-change, Nov.)	96.85	199.28	99.71	100.9
U.S. semiconductor bookings ($ millions, 3-month average, Nov.)	$1,165	$1,198	$1,135	$1,205
Weekly hours of semiconductor production workers (monthly average, Oct.)	40.0	40.7	40.8	40.1
Electronics components lead time index (1977 = 100, Dec.)	67.2	80.5	89.9	102.5
S&P's semiconductor stock price index (1970 =10, monthly average, Dec.)	54.9	52.0	57.1	54.7
Change in electronics-components inventories ($ millions, SA, Nov.)	-$6	$47	-$48	-$12.8
Contracts and orders for plant and equipment ($ billions, SA, Oct.)	$45.2	$42.1	$41.8	$43.4

SA = seasonally adjusted, all other data are not seasonally adjusted

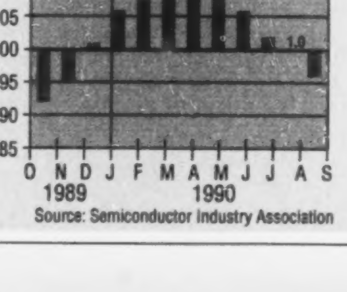
Sources: Semiconductor Industry Association, U.S. Bureau of Labor Statistics, *Electronics Purchasing* magazine, Standard & Poor's, U.S. Department of Commerce , U.S. Bureau of Economic Analysis

Semiconductor sales



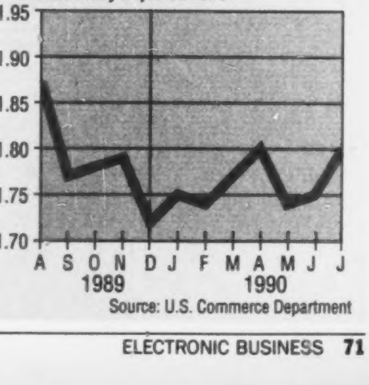
Source: Semiconductor Industry Association

Semiconductor book-to-bill ratio



Source: Semiconductor Industry Association

Component inventory-to-shipments



Source: U.S. Commerce Department

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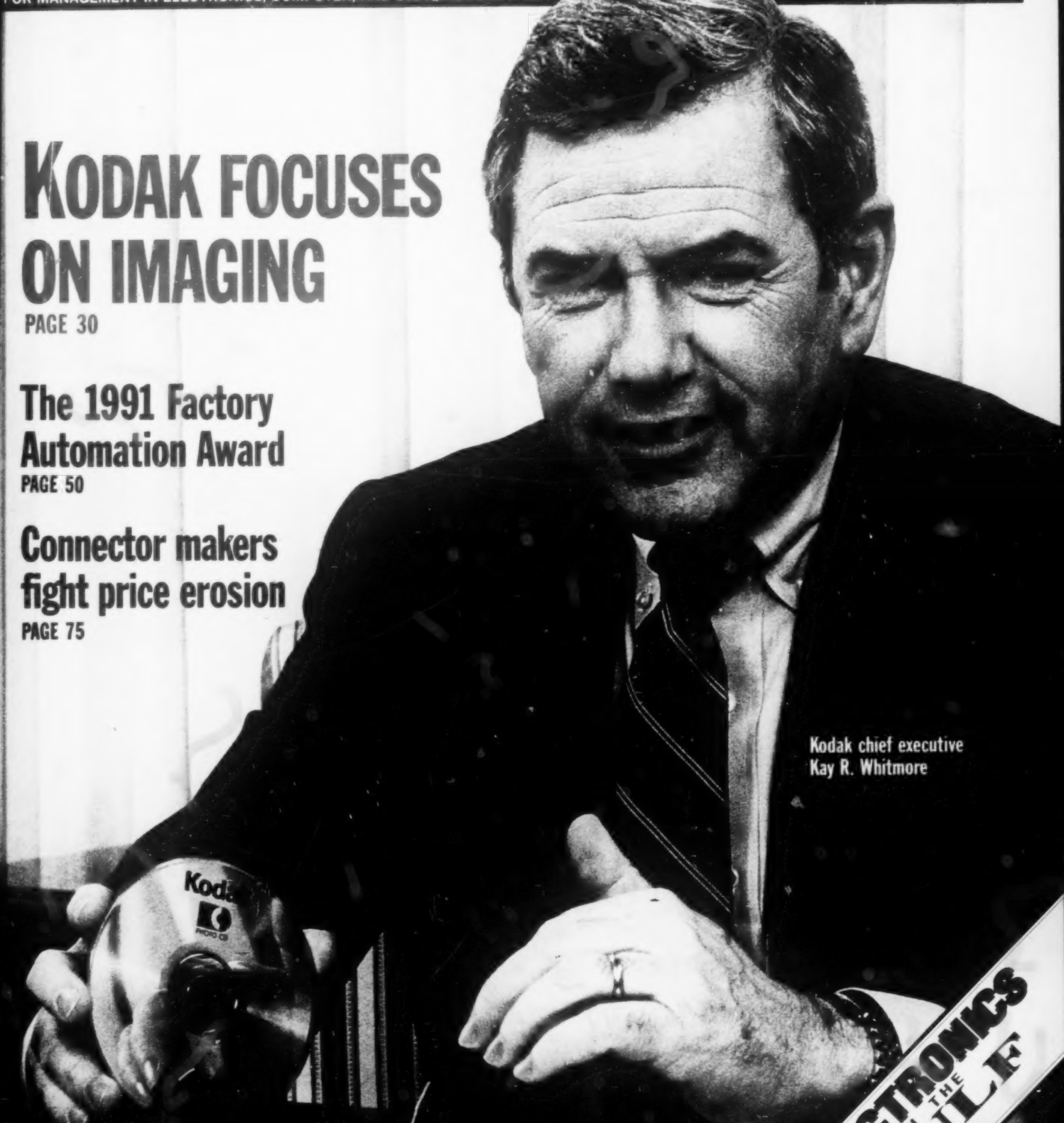

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The 1991 Factory Automation Award

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Connector makers fight price erosion

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Kodak chief executive
Kay R. Whitmore

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PAGE 30 Kodak chairman and CEO Kay Whitmore seeks new markets to counter sluggish growth in workhorse products

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30 Developing a new strategy at Kodak

Eastman Kodak Co. chairman, president, and CEO Kay R. Whitmore plans to make the company the hands-down leader in the new electronic-imaging market. But Kodak will need more than name recognition to succeed. It also must set the pace in establishing new industry standards, then prove that a big 110-year-old company still knows how to move quickly and decisively

Cover: Phil Matt

UPDATE

11 Business Trends

Decline in sales for desktop PCs; Cypress breaks ahead in slumping semiconductor industry; chip industry loses a legend; Taiwanese dealers look to service to help business; Lex aims to bolster image and profits; semiconductor market shows growth despite poor economic conditions; antitrust grounds seem solid in Semi-Gas case; slow growth expected for Japanese producers

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After building a worldwide empire in film and photography, $18 billion Kodak has set out to develop new technology for electronic imaging. That isn't surprising for a company whose name is all but synonymous with imaging. The trick now is to hit a fast-moving target without disrupting its core business

32 Kodak strategy hinges on commercial-imaging group

Despite its leadership in photography, Kodak is struggling with its all-important commercial-imaging group. With a loss in 1989, the unit is called Kodak's "weak link" by one analyst

34 The future of memories, according to Kodak

There are 250 million 35mm cameras out there, says one Kodak source. The company hopes that at least some of the billions of images created every year will end up being stored on Kodak's Photo CD instead of in a shoebox

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40 Defense electronics win early challenges

A few flaws aside, U.S. military technology performed with startling precision during the early weeks of the Gulf war. Some predict that the conflict will spark a new arms race based on brains rather than brawn

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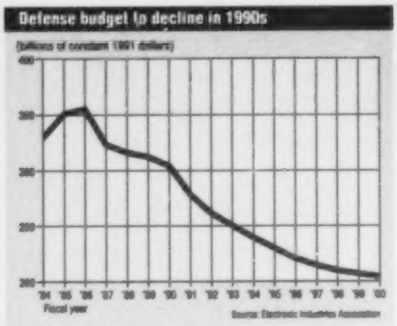
50 GE Fanuc rethinks the factory of the future

This year's winner of the Factory Automation Award goes to GE Fanuc Automation North America Inc. The Charlottesville, Va.-based manufacturing operation made its way to the top by focusing on the process rather than the technology. Now the plant is regarded as the cornerstone of the company

PAGE 75 ITT Cannon's Brian Bachman: Connector buyers can live with higher prices as the cost of supplier innovation



Source: Electronic Industries Association

PAGE 90 Defense budgets to decline

PAGE 79 Logitech CEO Pierluigi Zappacosta wants to add some pizzazz to the plain-vanilla mouse

PAGE 50 GE Fanuc's plant has 235 of its own products, and manager Dick Spinazzola (left), shown with VP Bob Wayland, shows it to customers about every other day

PAGE 40 Electronic weapons systems get their first test in the Gulf

EUROPE BUSINESS

59 Optical inspection makers tough it out in a slumping market

Sharing 80% of the global market in AOI machines for PCBs, Orbot and Optrotech seemed headed for the altar. Now that the merger has been called off, the two Israeli companies must find their own ways to cope with a lackluster market

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65 A big country with big plans —and big problems

Even though India's electronics industry has been flourishing over the past several years, it may soon hit a snag. To achieve the bold goals set by the government, the nation needs an eightfold increase in electronics exports in the next five years. The plans are ambitious, but are they realistic?

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Despite hard times, U.S. connector manufacturers are boosting prices—the first increases in years—to restore profitability and, they say, support R&D. But some claim that the real problem has nothing to do with price

79 In search of the high-fashion mouse

The development of Microsoft Windows 3.0 has made mice more popular than ever, making product differentiation a key selling point for some suppliers. It remains to be seen whether the lowly mouse can become a fashion statement

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Kodak hopes to create a world in its own image

Senior editor Rick Whiting: a glimpse of Kodak's future

Picture this: The grandfather of modern photography is going digital, going electronic. Forget those boxes of color slides. A compact disk will hold all your photographic images; you can call them up on your PC or workstation, crop them, size them, and print them out.

That's how Eastman Kodak Co. plans to revolutionize photography. Kodak's future vision extends further, focusing on its role as standard bearer for a range of desktop-imaging hardware and software technology, reports senior editor Rick Whiting in our cover story.

Kodak dubs its revolution-in-the-wings a case of "silver meeting silicon." Analysts say it is also a strategy for survival: meeting the competitive challenge of electronic imaging on the one hand and cutting dependence on a slowing market for standard photographic products on the other. But can a hierarchical 110-year-old company become a fast, flexible, high-tech player? We won't wait long to find out; the first photo CD products are just months away.

The Kodak story speaks to the need for executives to anticipate, manage, and implement the technology of the 1990s. Ironically, most of us had hoped that some of the industry's most effective technology would never have to be implemented at all. But in the early evening hours of January 16, millions of TV viewers, gripped by an odd blend of dread and fascination, became the first Americans to watch the nation go to war right before their eyes.

It soon became obvious that this would be unlike any other war in history. Less than a week after the first Allied sorties, a team of ELECTRONIC BUSINESS writers—senior editor Rick Whiting, associate editor Peter Burrows, and assistant editor Barbara Jorgensen—literally dropped everything to pull together our special report on "Electronics in the Gulf."

The early verdict, according to one defense expert, is that U.S. electronics technology has performed with "startling" success—especially the Patriot antimissile missile, produced by Raytheon Corp., Martin Marietta Corp., and several subcontractors. That, reports Whiting, poses another irony: The Patriot was nearly scrapped during the 1970s because of its poor performance and cost overruns.

Will the successes of these weapons spark another worldwide arms race? Probably not, although experts predict that the events of the past month or so could slow the deterioration in defense spending. In any event, there is little doubt that the proven reliability of "smart weapons" has changed the nature of warfare forever.

JOHN PARKER & GARRETT DeYOUNG

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signal pickup devices from the outside. It also uses a Standard Machine Interface production automation line wherein wafers or chips are moved about in airtight, line-dockable containers to prevent contamination.

Cypress, according to Rodgers, will re-rig the plant to build 64K SRAMs it had been making at its Round Rock, Tex., facility. This is largely because Cypress "can't fill demand" for 64K and 256K SRAMs, and Round Rock didn't afford the necessary capacity to meet demand. Round Rock is slated to become a Sparc chip plant when the conversion takes place sometime early this year. The facility will be run as a subsidiary, Cypress Minnesota Inc.

Rodgers says Cypress would discontinue the military application chip production VDT started, calling prices in that business "astronomical." The CMOS logic chip business is also out the door, but a single-chip VME production line with 14 employees will stay.

DAVID WEBB in San Jose

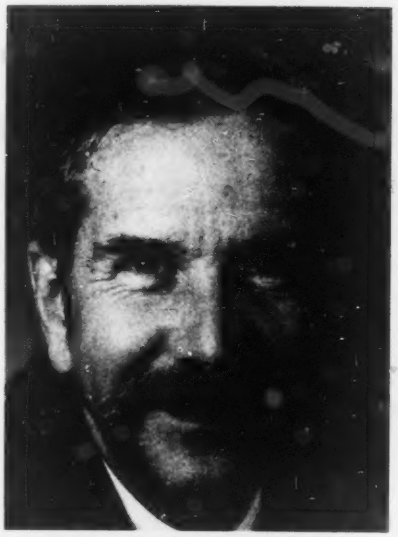
EXECUTIVES

Chip industry legend opts for retirement

AFTER MORE than 25 years at the helm of National Semiconductor Corp., Charles E. Sporck, 63, says he will leave Santa Clara, Calif.-based National for retirement.

Sporck handed over control of National to Gilbert Amelio, most recently president of Rockwell Communication Systems. Amelio started work at National early this month and will share an office with Sporck until the retiring CEO leaves the company in May. With Amelio gone, Rockwell Communications Systems will be headed by 51-year-old executive vice president and chief operating officer Kent M. Black.

An elder statesman of the industry, Sporck was one of the first chief executives to stress the importance of manufacturing in the semiconductor business. Some say he is still more comfortable on the factory floor than in the boardroom. Sporck's belief in manufacturing led him to become the driving force behind the formation of Sematech, the chip-making consortium. With his retirement from National, Sporck will also step down as chairman of Sematech, and Motorola chairman Robert Galvin, 67, will replace him.



Charles Sporck prepares for life after National Semiconductor

Sporck's decision to retire comes at a time when National is emerging from several years of heavy losses and layoffs. Sporck took direct control of the company almost two years ago in an attempt to turn National around, but his efforts were only partly successful. In its most recent quarter, the company posted its first operating profit in some time, but analysts say it is still short of full recovery.

Amelio, 47, will have his hands full making sure National makes a complete recovery, say analysts. In particular, they say, the company must shift its emphasis from commodity products toward chips with higher prices and added value. Although some feel National desperately needs the infusion of new management styles, others worry that Sporck might be leaving too soon.

But Amelio, who has a doctorate in physics and holds 16 patents, downplayed National's problems in several interviews and stressed that he was not going to rush the company into major changes.

Sporck, meanwhile, says he has no plans to get back into the chip business. Instead, he says, he will spend time with his family and savor the novelty of being without a job for the first time since he left grade school.

VALERIE RICE in San Jose

TAIWAN PCs

Service a major worry for Taiwan's PC dealers

IN THE CLONE kingdom of Taiwan, local dealerships provide a major outlet for U.S. manufacturers of PCs. But what are those Taiwanese dealers looking for from foreign vendors?

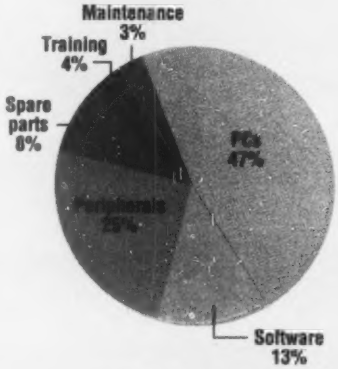
Sufficient technical support, reliable quality, and appropriate profit margins are the major concerns for the Taiwanese dealers when they choose PC suppliers, according to a recent survey conducted by the Taipei-based Market Intelligence Center (MIC) at the Institute for Information Industry, a government-sponsored market research institution. The survey covers 224 PC dealers scattered all over the island country and selling a total of 487,000 PC units in 1989.

Of all the dealers, 66% say the technical support and service provided by the PC vendors is the most important factor to their business.

Among the foreign vendors, IBM has received a score of 67% approval in its technical support, only trailing NEC's 78%.

But the U.S. vendors seem to have priced their products too high in Taiwan; 83% of the respondents to the MIC survey judged products made by IBM unsatisfactory in terms of price, 75% were unhappy with Apple Computer Inc.'s prices, and 63% were dissatisfied with prices from Wang

What Taiwan's PC dealers sell



Source: Market Intelligence Center, Institute for Information Industry (Taiwan)

CAPITAL SPENDING

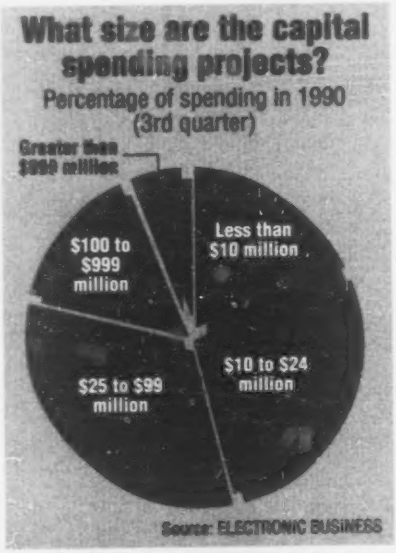
Slowing sales put squeeze on capital-spending plans

UNCERTAINTY and caution combined during the third quarter of 1990 to put the squeeze on electronics companies' capital-investment plans. Results from the third ELECTRONIC BUSINESS capital-spending poll show, more than ever, electronics chief financial officers are planning to cut capital spending.

Of the 61 CFOs surveyed during the last quarter of 1990, only 25% admitted to having spent less on new equipment and factories during the year than in the previous year. Yet questioning about their quarterly spending habits and plans clearly showed that top electronics manufacturers slashed near-term capital budgets: More than half of all CFOs indicated that plant and equipment spending in the third quarter of 1990 had fallen from second-quarter levels, and 47% said spending had dropped from year-ago levels; only 18% said capital investment rose from the second to third quarters of 1990.

The forecast for capital spending has become progressively worse as well. When ELECTRONIC BUSINESS first asked electronics companies about their investment plans last spring, an encouraging 38% of the respondents were planning to step up investment in the upcoming quarter. Later that summer, 32% of CFOs surveyed were still optimistic about their near-term spending plans. According to the latest survey, however, only 21% actually approved increases in capital budgets for the next quarter; the rest expected capital spending to fall during the next three months (45%) or to stay the same (34%).

The culprit in the electronics industry's capital budget stand-off? The economy. Contrary to the popular perception about the sanctity of the current capital budget, over half of those surveyed said the biggest constraint on their spending plans is the expectation that their company's sales will not increase significantly in the near future.



What size are the capital spending projects?

Percentage of spending in 1990 (3rd quarter)

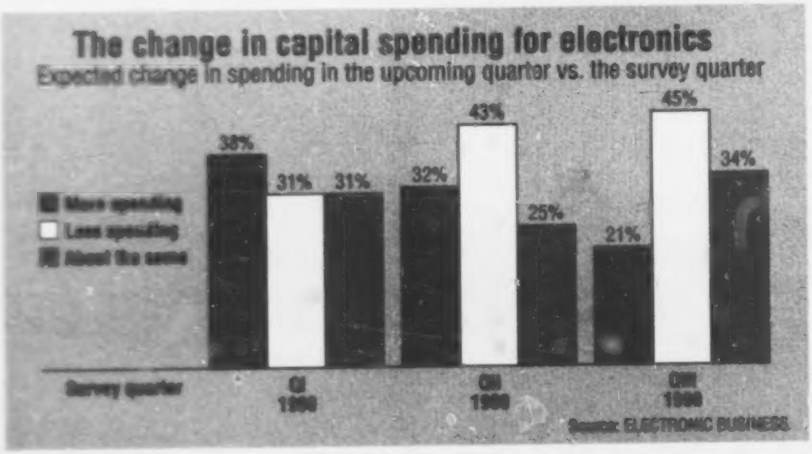
Source: ELECTRONIC BUSINESS

Last spring 19% of those surveyed spent over $1 million on a big-ticket piece of equipment during the previous quarter; in the latest study, only 13% reported spending more than $1 million on a single investment. This may or may not be a significant trend, however, since survey respondents who qualify as large companies (which we define as those with 1989 sales of more than $100 million) fell slightly when compared with the first survey.

Total investment by all U.S. companies in computers and information processing equipment slowed in the middle of the past year. According to the Department of Commerce, overall investment grew only 1.4% in the second quarter of 1990 and 2.2% in the third quarter (both compared with year-ago figures). Those gains, which are not adjusted for inflation, are the slowest increases since the 1986 electronics industry recession. Overall investment in computers alone fell 3.7% from a year ago.

With all industries cutting back on their purchases of technology equipment, the sales outlook for electronics companies making computers and high-tech capital equipment looks weak. The downward spiral of a recession has begun. The nagging questions are: How low will the figures go before hitting bottom, and how long will the recession batter the U.S. electronics industry's capital-investment plans?

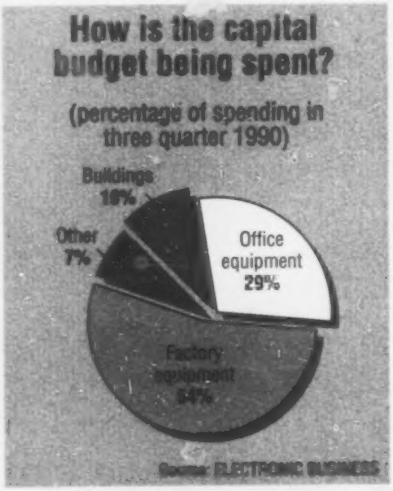
ELIZABETH BAATZ and XIONG XIAOGE



The change in capital spending for electronics

Expected change in spending in the upcoming quarter vs. the survey quarter

Source: ELECTRONIC BUSINESS



How is the capital budget being spent?

(percentage of spending in three quarter 1990)

Source: ELECTRONIC BUSINESS

A big country with big plans —and big problems

India's electronics boom has started with TV manufacturing, but shortages of components and cash could stall it

BY JOHN RIBEIRO

Roughly four times larger than it was five years ago, India's electronics industry has been booming. But in order to meet ambitious government targets set for 1995, it will have to keep booming.

According to figures from the Government of India Department of Electronics (DOE), electronics enjoyed compounded growth of more than 35% during the country's seventh Five-Year Plan for economic development, from 1985 to 1990, a period that saw output increase from $1.2 billion to $5.1 billion. The figures have not been adjusted to reflect inflation and the depreciating rupee over the life of the plan.

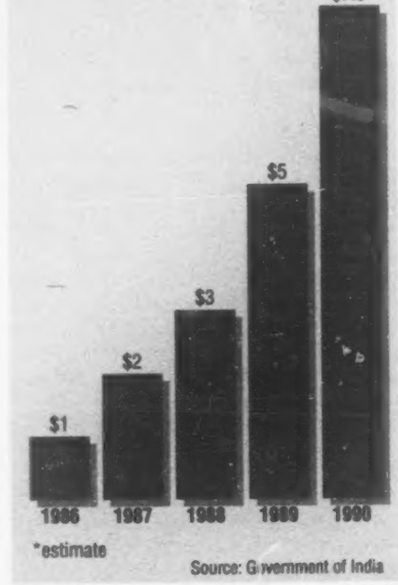
The heart of India's electronics industry, which accounts for nearly 20% of the country's total electronics output, is in leafy Bangalore—dubbed India's Silicon Valley—in south India's Karnataka state. Though not as stretched and strained as other industrial centers, Bangalore has a temperamental communications system and mercurial power supply, pressuring some companies to establish in nearby Mysore or elsewhere.

But bustling as Karnataka's electronics industry is, the state has a declining share of India's overall electronics, a situation that reflects more the hyperactivity in other parts of the country rather than sluggishness in the Bangalore area.

The boom has been fueled by low-end consumer production, mostly televisions. It started with liberalized economic policies introduced by the first Rajiv Gandhi government, which in 1984 implemented the Computer Policy and the Telecom Policy. A new strategy, called Integrated Policy Measures in Electronics, also helped when it went into force the following year.

The initiatives eased restrictions on both technology imports and manufacturing licensing, while removing the licensing of the components industry, thereby opening the electronics arena to private companies that have up to 40% foreign equity.

The government's attitude toward the private sector in recent years is reflected across India's industrial landscape, as Bangalore's *Economic Times* noted in its report on the public sector's fast-declining share of the electronics industry. In one report over year ago, the newspaper pointed out that in the early 1970s, government-owned companies controlled 90% of production in Karnataka state but today controls just over half. "By 2000," the *Economic Times* said, "[private companies] will account for 90% of the total electronics production."


India's electronics growth

*estimate
Source: Government of India

No turning back

With winds of change blowing across the country, the private sector started to make telephones and switching exchanges, once the preserve of the public sector. Eventually, the Telecom Policy was amended to allow the private sector to manufacture switching equipment of up to 2,000 lines capacity and multichannel radio relay systems of up to 12 channels.

The National Front government of Prime Minister V. P. Singh—a fragile coalition—had been expected to liberalize policy further, before being replaced by a new coalition headed by Chandra Shekar.

The general consensus seems to be that no matter which party or coalition of parties governs the country, there is no turning back to the centralized economic stagnation of the past. Nevertheless, government and company officials alike were prepared to talk about developments only off the record.

The consumer sector, specifically television manufacturing, was the quickest to respond to the changes because the conditions for growth had already been laid in 1982 when the government television network, Doordarshan, introduced color and expanded services.

But other sectors also enjoyed significant growth during the seventh Five-Year Plan. Computer systems output, for example, grew from $52.8 million in 1984 to $416.7 million in 1989. In that time, the sector widened activity beyond manufacturing

IBM-compatible personal computers to making minis, super-mini computers, workstations, and mainframes—although the more sophisticated the technology, the higher the import bill for foreign parts.

Liberalization brought in multinationals like Digital Equipment Corp., Hewlett-Packard Co., and Groupe Bull S.A., each setting up joint ventures. Deregulation also lured new domestic players into telecommunications equipment manufacturing, some of them working with offshore partners under a centralized technology government purchase scheme. Not surprisingly, India's own big computer companies, such as HCL ltd. and Wipro Information Technology Ltd., also managed to flourish during the Rajiv Gandhi era.

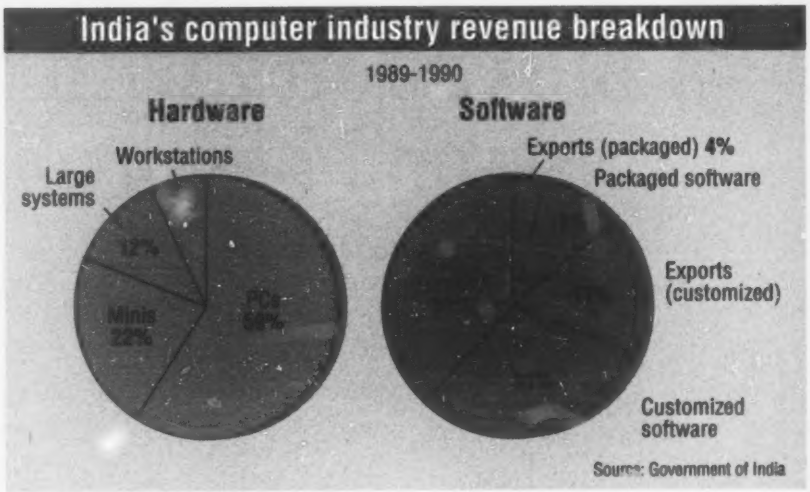
In 1984 the government set up the Center for Development of Telematics (C-DOT) in order to develop electronic switching systems. C-DOT's efforts generated important by-products, among them a 128-port PABX and a 128-port rural automatic exchange. With further liberalization, the technology for both switches was licensed to Indian Telephone Industries (ITI), which created a large manufacturing base for switching systems in the bargain.

C-DOT has reportedly slipped behind current targets to develop a large exchange, although the Department of Communications at Bangalore felt sufficiently confident to commission it to develop a 4,000-port configuration of its C-DOT switch.

ITI's electronic switching systems factory at Mankapur in North India's Uttar Pradesh state accelerated production of E-10B exchanges under technology-transfer agreements with CIT-Alcatel. Production of the exchanges increased from 175,000 lines in 1987 to a target full-capacity production of 500,000 lines this year.

But delays in large-exchange development at C-DOT may precipitate a shortage of large exchanges, a potential problem the private sector hopes to circumvent through joint-venture manufacturing arrangements with multinationals.

Consumer electronics accounts for the largest share of production. In 1989 the sector had an estimated production of $1.8 billion, more than 33% of all production. That said, computers posted the strongest growth during the period—51%—mainly because volume stood at a comparatively low $52.8 million at the beginning of the seventh Five-Year Plan.


India's computer industry revenue breakdown

Source: Government of India

The consumer sector followed, posting 38% compounded growth over that period. Television production was the driver: In 1988, for example, production of color and black-and-white televisions accounted for $1 billion out of the consumer sector's $1.5 billion total.

No matter which party governs, there is no turning back to centralized stagnation of the past

Six million televisions, most of them black-and-white, were produced in 1988, compared with only 1.45 million in 1984. But indications are that demand has reached a plateau.

Led by Bangalore's BLP Group and others, video cassette recorder production has started. The DOE estimates that the Indian video industry will produce up to two million units by 1995, accounting for a turnover of $777.8 million.

The consumer range is expected to grow beyond its current focus on televisions, helping to hold the sector's commanding share of activity over the course of the eighth Five-Year Plan, which runs from 1994 to 1995.

Components are the sore point. In 1987, for instance, roughly 52% of components were imported. But with domestically made color tubes and other components becoming available, that figure is expected to drop to 40%.

The components industry grew 38% in the past five years, output reaching $888.9 million this year, thanks mainly to consumer activity and to television-parts manufacturing in particular.

Component crunch

Nonconsumer electronics haven't fared nearly as well on the components front. A report from the Bureau of Industrial Costs and Prices of the Ministry of Industry estimates that imported components can run as high as 83% of material costs (excluding duties) of personal computers. That estimate also tallies in the import content in domestically made electronic components.

The DOE came to the same dismal conclusion after commissioning its own Study Team on Electronic Components for the eighth Five-Year Plan. The agency found that electronics content accounted for 31% of products, and 85% of the electronics content was imported.

The group found that the components industry was much too fragmented, a situation that worked against achieving viable economies of scale: Domestically produced components that can cost twice as much as those that are available from overseas manufacturers in the world market.

Its study also found that local manufacturers can't keep in step with ever-changing technology and depressingly short product life cycles. Instead of redesigning products around locally available components, India's downstream manufacturers import designs and make products to their specifications—using short runs of imported components local producers can't hope to make and earn money on.

There are exceptions to the rule in both consumer and nonconsumer areas. For instance, some component manufacturers have stepped up capacity in black-and-white television tubes, electrolytic capacitors, and ferrites.

Indeed, excess capacity on some production lines has stimulated exports. India is currently exporting these and other products.

Inevitably, imbalances have occurred. India's commitment to supply Soviet manufacturers with one million color tubes, for example, has left some television manufacturers high and dry, forcing them to source offshore.

By 1995, according to DOE estimates, 25% of the demand for components will continue to be met by imports. A critical area will continue to be large-scale and very-large-scale integrated devices. To reduce dependence on imported chips, parliament recently approved a $101.8 million package to refurbish the publicly owned Semiconductor Complex Limited (SCL) to be implemented by 1992.

Industry insiders say SCL is planning to set up a 6-inch wafer foundry, using 1-micron bipolar complementary metal-oxide semiconductor (BiCMOS) technology, with foreign partners. One may be Austria's Mikro Systems A.G., which provided SCL production capacity after its fab was gutted by fire last year.

Some industry watchers argue that even the new, improved SCL won't make enough devices to meet local demand—even with business swelling to a projected $27.8 million annually.

ITI, which runs a 4-inch wafer foundry making 3-micron CMOS gate arrays and standard application-specific integrated circuits, got the government's go-ahead to set up a 5-inch wafer foundry using 1.5-micron CMOS technology, primarily to manufacture ASICs.

San Jose, Calif.-based VLSI Technology Inc. is a technical partner in the venture that is expected to create a $27.8 million business.

Bangalore's Bharat Heavy Electronics Limited and subsidiary Bharat Electronics have also made plans for setting up their own foundries. Besides these public-sector companies, one private company, Usha Rectifiers Ltd., appears ready to set up a foundry for 3-micron, 4-inch wafers.

The DOE is aiming for 27% overall growth for electronics over the course of the eighth Five-Year Plan, hoping for a volume of $16.7 billion by 1995. Highest growth is expected in software exports, which are projected to swell

All you need to know about 5.25" Winchester disk drives, inside

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60% to $11.1 million by 1995, the last year of the plan. Consumer electronics will continue to dominate, say government officials who predict volume reaching $4.7 billion in 1994.

Aiming high

To achieve these targets, the government says $3.3 billion has to be invested, half of that in the components sector. The downside includes running up a sizable import bill—from the current $1.1 billion for 1989 to $3.5 billion by 1994.

The eighth Five-Year Plan could stall without a concerted effort to boost exports to the limit to earn the cash to pay for imports. And since the introduction of this year's new industrial policy, pressures have mounted to decrease import allowance for plant and machinery.

The DOE says that by 1995, the net foreign exchange requirement would only be $27.8 million if exports raised the targeted $3.5 billion it is hoping for. How ambitious is the plan? It requires more than an eightfold increase in electronics exports in the next five years.

Exports—including those from domestic software houses, export-processing zones, and 100% export-oriented companies—were only $416.7 million in 1989. To achieve the projected leap, the DOE has selected several product groups to fuel the drive—among them, televisions, telecommunications exchange equipment, dish and microwave antennas, personal computers and peripherals, as well as software and software consulting services.

In the components area, where domestic needs are too piecemeal now to develop a viable supply stream, the government is trying to encourage an export drive to achieve economies of scale at home.

Are DOE planners dreaming merely in black-and-white or in full-blown technicolor? An awful lot of complex elements will have to fall neatly into place for India's aims to be realized. Only time, about five years of it, will tell. ☐

Indian information technology revenue

[illegible]		[illegible]	[illegible]	Growth
48.40%	**Hardware**	292.42	415.94	42.24%
6.29%	**Software**	28.70	54.18	88.78%
9.26%	**Peripherals**	53.91	79.69	47.82%
1.34%	**Memory Media**	5.23	11.52	120.26%
4.37%	**Training**	14.93	37.59	151.77%
1.31%	**Agency operations**	10.18	11.30	11.00%
14.63%	**Exports**	66.91	125.98	88.28%
9.19%	**Maintenance**	56.75	80.00	40.98%
5.11%	**Other**	65.89	44.00	-33.21%
	Total	[illegible]	[illegible]	[illegible]

Source: Government of India

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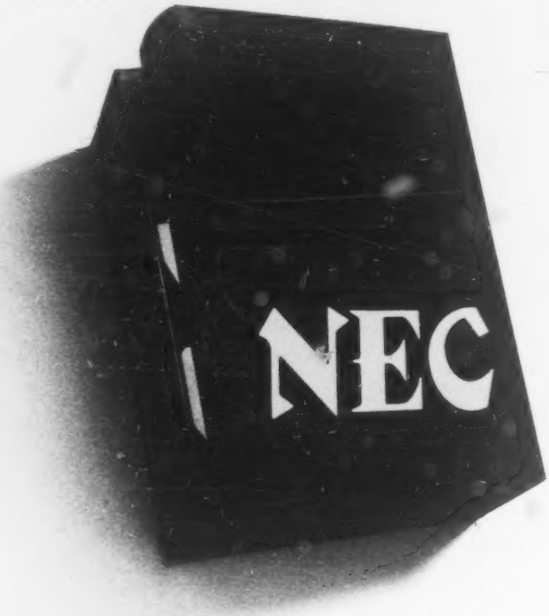


But all you really need to know is that they're made by NEC, a 24-billion-dollar company, and the fourth largest manufacturer of disk drives in the world. For more information, call 1-800-NEC-INFO.

NEC

In search of the high-fashion mouse

Vendors are betting that a new set of clothes will make the dowdy commodity devices more appealing to a wider range of buyers

BY DAVE WEBB

If Pierluigi Zappacosta has his way, every microcomputer system user would end up buying not just one mouse or trackball from Logitech, but two.

First, he says, he would sell one through a system OEM vendor, which tends to buy low-cost, no-frills mice to package with its systems. Then when the computer makes it to the user's desk, Zappacosta would be there to market a second, more "fashionable" mouse or trackball that would please the user in much the same manner as a new style of jeans or sunglasses.

Logitech CEO Pierluigi Zappacosta wants to add some pizzazz to the plain-vanilla mouse

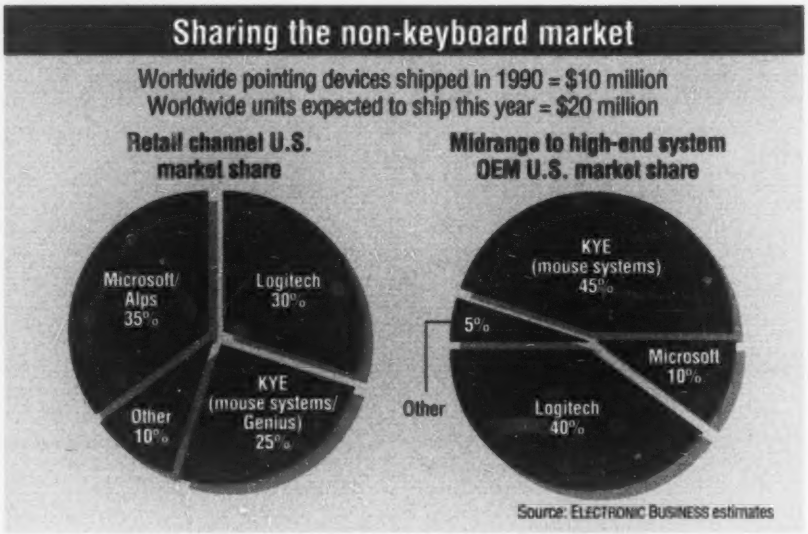
"We want people to look at the mouse sitting next to their computer and say, 'I like it. It's cool,'" says the president and CEO of Swiss-owned Logitech Inc. in Fremont, Calif., one of the handful of independent, non-keyboard input device suppliers.

Not everyone may agree, but Zappacosta insists that users can actually become attached to products they use on a daily basis. "Look at what Swatch did for the watch," he enthuses. "It was a commodity product, yet those guys figured that people wanted something different, something that would make them stand out as individuals. They have been tremendously successful. We are hoping we can do the same."

Hoping implies a bit of apprehension on the part of Zappacosta and his staff, but his ideas about marketing input devices such as mice, which quickly became commodity items after Apple Computer Inc. popularized them for use in its Macintosh, may be what it takes for the independents such as Logitech to survive in this low-margin business. Little data is available about the non-keyboard input device market, but among mice, trackballs, stylus pointers, and so-called isopoint bars, mice shipments make up the dominant share of the non-keyboard microcomputer input device market. And because there is little to do in order to improve upon the technology of a mouse, vendors have started to recognize that the mouse can be upgraded in other ways. As in any commodity market, differentiation is critical; companies such as Logitech are embracing the idea that making a mouse fashionable can attract buyers to what is a plain-vanilla product.

Not all vendors agree with Logitech's approach. "We know damn well we are working in a commodity market," says John Murphy, vice president of sales and marketing for Mouse Systems Inc. in Fremont. "And it is a bit of a fashion market, that's true. But we take the opposite viewpoint [from Logitech]. We want to sell just one mouse to each person and give them a product they won't want or need to switch from."

As a result, the three largest U.S. market suppliers—Mouse Systems, Logitech, and San Jose-based Alps Electric, which supplies mice to Microsoft Corp.—are focusing on ergonomics, or making the devices easier to use. Both Logitech and Mouse Systems are gearing up marketing campaigns around right- and left-handed versions of products designed to be held as naturally as possible while in use. And both are delivering different sizes to accommodate small and large hands; Zappacosta suggests his company may even come



Sharing the non-keyboard market

Worldwide pointing devices shipped in 1990 = $10 million
Worldwide units expected to ship this year = $20 million

Source: ELECTRONIC BUSINESS estimates

up with a third, medium-size mouse to fill out its ergonomic product set.

"I really don't believe it is crazy for us to believe the mouse can be some sort of fashion statement," Zappacosta says. "Making it feel right is a part of addressing this issue of personalizing the computer to the individual."

The mouse segment of the input device market can be divided into three segments: the high-end microsystem OEM market, the low-end microsystem OEM market, and the retail/distribution market. Until recently (and especially before the availability of Microsoft's Windows version 3.0), mice were largely confined to use in Macintosh environments. As some software programs under early versions of Windows became available, mice began to see use in IBM PCs and compatibles, but it wasn't until Windows 3.0, which brought many Mac-like ease-of-use features to the IBM world, that mice became an integral part of a system.

Mouse Systems, which was purchased by the Taiwanese electronics manufacturer KYE International late last year, appears to have a clear market share lead in the high-end desktop personal computer and workstation market. Its customer list includes Sun Microsystems Inc., Silicon Graphics, Concurrent Computer Corp., Siemens A.G., and Data General Corp. for its cordless, optical, and conventional mice. Mouse Systems claims its share of the low-end system and distribution-channel presence is about 30%, about even with Logitech and well behind Microsoft. A slew of other retail-channel vendors supplying mice and trackball devices includes KYE (with its Genius trademark products), Keytronics, IMSI, Kensington Microware Ltd., and Microspeed Inc.

Logitech is squarely anchored in the low-end desktop system OEM market, where Zappacosta says 60% of its business is targeted. Logitech's customer list includes Sun Microsystems Inc., Silicon Graphics Inc., AST Research Inc., and "just about all" of the major PC-clone vendors. The remaining 40% is largely retail distribution, where the company has charted an aggressive head-on marketing strategy to unseat Microsoft and its powerful Windows 3.0/mouse package marketing scheme.

The three largest U.S. market suppliers are focusing on ergonomics—making devices easier to use

Other pointing devices don't seem to have the appeal of mice. Nevertheless, everyone except Microsoft (which sells only mice) is marketing an alternative such as a trackball, stylus pen, or the isopoint bar, which Grid Systems Corp. integrated into one of its latest laptop computers. Touchscreen technology has yet to gain significant market interest.

Market to double?

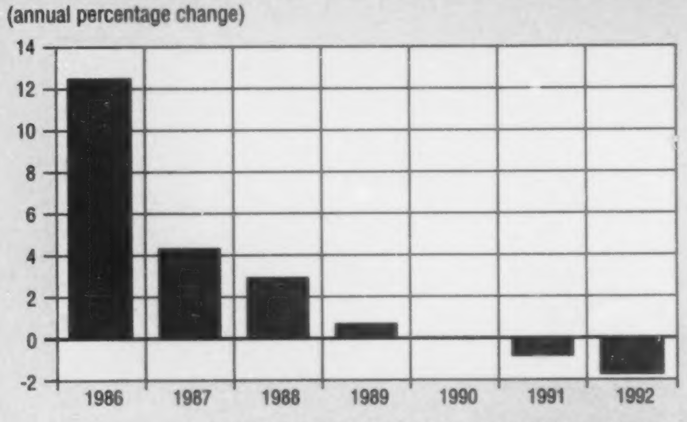
Ironically, it is Windows 3.0 that is spurring demand across the board for pointing devices, with mice at the forefront. For Microsoft's competitors, it has been as much of a boon as it has been a competitive hurdle in the market, especially in the retail channel. "Mice sales are running rampant," claims Steve Ashe, director of sales and marketing at Computerland. "With sales of Windows and Windows 3.0, we have seen a significant increase in the number of mice we sell, and they are continuing to grow." Other retailers voice similar claims.

"With Windows [3.0] and the new graphical user interfaces, it is becoming okay to use a mouse in the PC world," says Mouse Systems' Murphy. "Two to three years ago you couldn't get DOS users to use a mouse, but that has changed in the last 18 months."

Logitech's Zappacosta says his company was on a 500,000-unit-per-month run rate in December and estimates that in calendar 1990 the company shipped 4 million of the 10 million mice shipped last year. He says the worldwide market will double to 20 million by the end of this year. If his strategy pays off, Logitech will get 50% of the market in 1991. "The main issue for us is whether we will be able to overtake Microsoft in the retail market," he says.

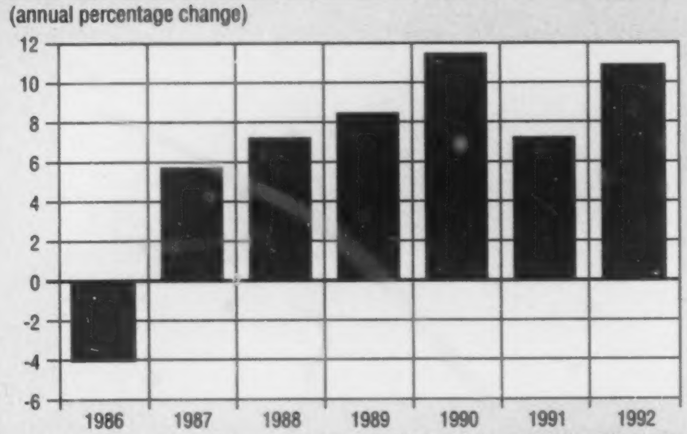
The main issue for Mouse Systems, meanwhile, will be to maintain a leading-edge technology stance above the competition, Murphy says. "People in the high-end workstation market are buying performance," he says. "They want compatibility with their software, accuracy [of the pointing device], and ergonomic designs. Ergonomics by itself can play a big difference in the market."

The company is focusing on new product designs such as its optical mouse, which operates on a grid pad with much more accuracy than a conventional ball-type mouse. Murphy claims than an optical mouse continues to read accurately over time while a conventional ball mouse can wear out and get sloppy, resulting in a 10% loss of accuracy over time. ☐



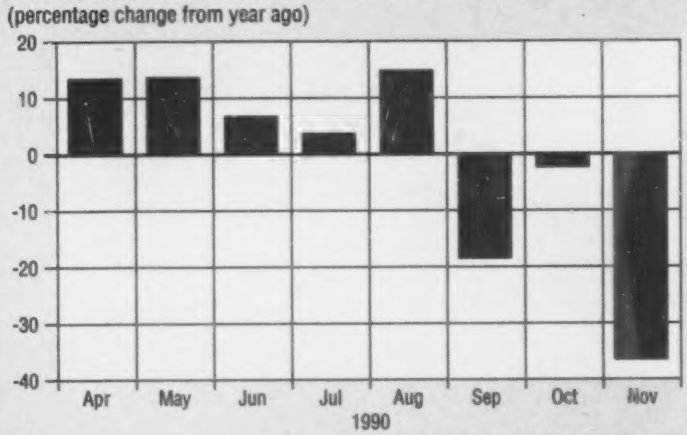
Defense communications equipment shipments

Source: U.S. Department of Commerce; forecasts: Cahners Economics



Commercial communication equipment shipments

Source: U.S. Department of Commerce; forecasts: Cahners Economics



Communication equipment new orders

Source: U.S. Department of Commerce; forecasts: Cahners Economics

Communications equipment orders down

Shipments of communications equipment grew an estimated 6.3% to $82.7 billion in 1990, a relatively healthy figure given the condition of some other electronics markets and the overall economy. But, if recent trends in new orders are any indication, the industry can expect rough sailing ahead.

The shrinking of orders for communications equipment below year-ago levels began in September of last year and was exacerbated by the plunge in business confidence.

The damage became apparent this past November when orders for communications equipment tumbled 18.6% from October and dove 36.8% from the total orders in November 1989. A drop in defense communications equipment orders contributed the most to the decline, although orders for commercial communications equipment also dropped about 4% from a year ago. The monthly trend in communications equipment orders has always been volatile, but the industry had never before experienced a single monthly decline of this magnitude. Despite the military needs created by the Middle East crisis, the end of the Cold War brought cuts in orders for military radar, sonar, and navigation equipment.

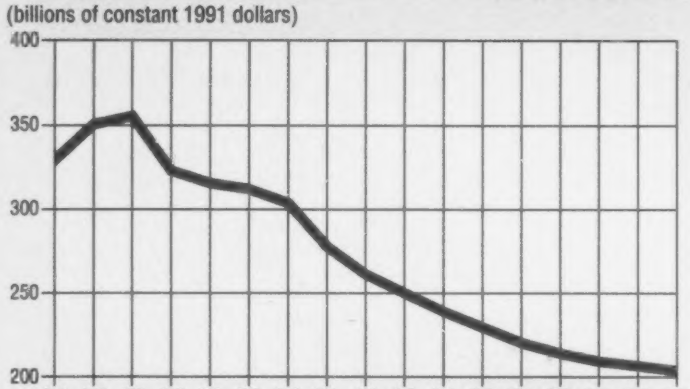
As a result of the weak demand from the military, growth of communications equipment shipments will be slower this year compared with 1990. Cahners Economics expects total shipments to advance 3.7% in 1991. This forecast assumes a decline in defense shipments and about 7% growth in commercial shipments as networking continues its spread across corporate America.

One reason the industry will skirt a serious contraction in 1991 stems from its relatively high backlogs of $61.2 billion—almost 8.8 times its level of monthly shipments. So, the industry has some fat to sustain itself should the current recession last longer than expected.

MADELINE FRANCHI

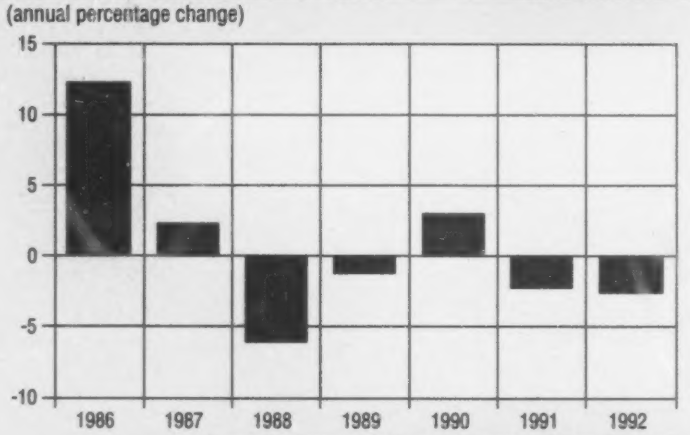
For more information on Cahners Economics' forecasting services, including seminars, newsletters, and database diskettes, contact Dan Buchan at (617) 630-2105; by fax at (617) 630-2100; or write Cahners Economics, Cahners Publishing Co., 275 Washington St., Newton, MA 02158

Defense budget to decline in 1990s



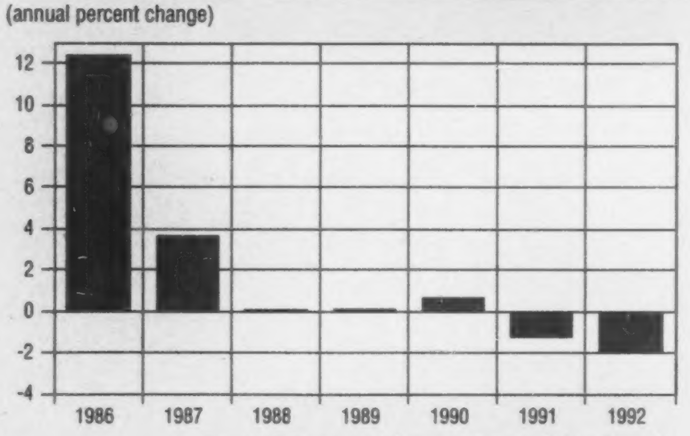
Source: Electronic Industries Association

Defense aircraft and parts shipments



Source: U.S. Department of Commerce; forecasts: Cahners Economics

Military electronics shipments



Source: U.S. Department of Commerce; forecasts: Cahners Economics

Defense faces lean years despite Gulf conflict

Defense contractors will have to battle through budget cuts and declining global demand in order to survive this decade, as the federal budget deficit and the shaky financial industry will remain the prevailing concerns in Washington.

According to the Electronic Industries Association's 10-year forecast for the defense industry, the U.S. defense budget will decline one-third, from $302.8 billion (in constant 1991 dollars) in fiscal year 1990, to $203.5 billion in fiscal year 2000. The Persian Gulf crisis will not halt these cuts but will temporarily slow down the decline.

One area benefiting from the Iraqi invasion will be the aerospace industry. A potentially large market for U.S. military aircraft will reopen, and according to the Department of Commerce's 1991 U.S. Industrial Outlook, sales to the Middle East are expected to increase this year. However, this will not offset the decrease in demand elsewhere. Cahners Economics forecasts defense aircraft and parts shipments to fall 2.3% in 1991, followed by a further decline of 2.6% in 1992.

The 1980's movement toward creating new systems is being abandoned in favor of upgrading existing equipment. This strategy will benefit the electronics industry by including a higher percentage of electronic parts in current systems. But, once again, the gains made through this means will not be sufficient to overcome budget cutbacks. The results for 1991 are expected to show military electronic shipments slipping 1.3%, while 1992 will see another 2% reduction.

The battle to survive in this industry will be fierce, and most companies have already laid down their plans. Success will come to those that can offer cost-effective upgrades and to those that diversify into new areas such as environmental sensor and cleanup systems and drug interdiction. All in all, expect lean years ahead for the defense industry with the electronics sector feeling the pinch as well.

JOHN FARRELL

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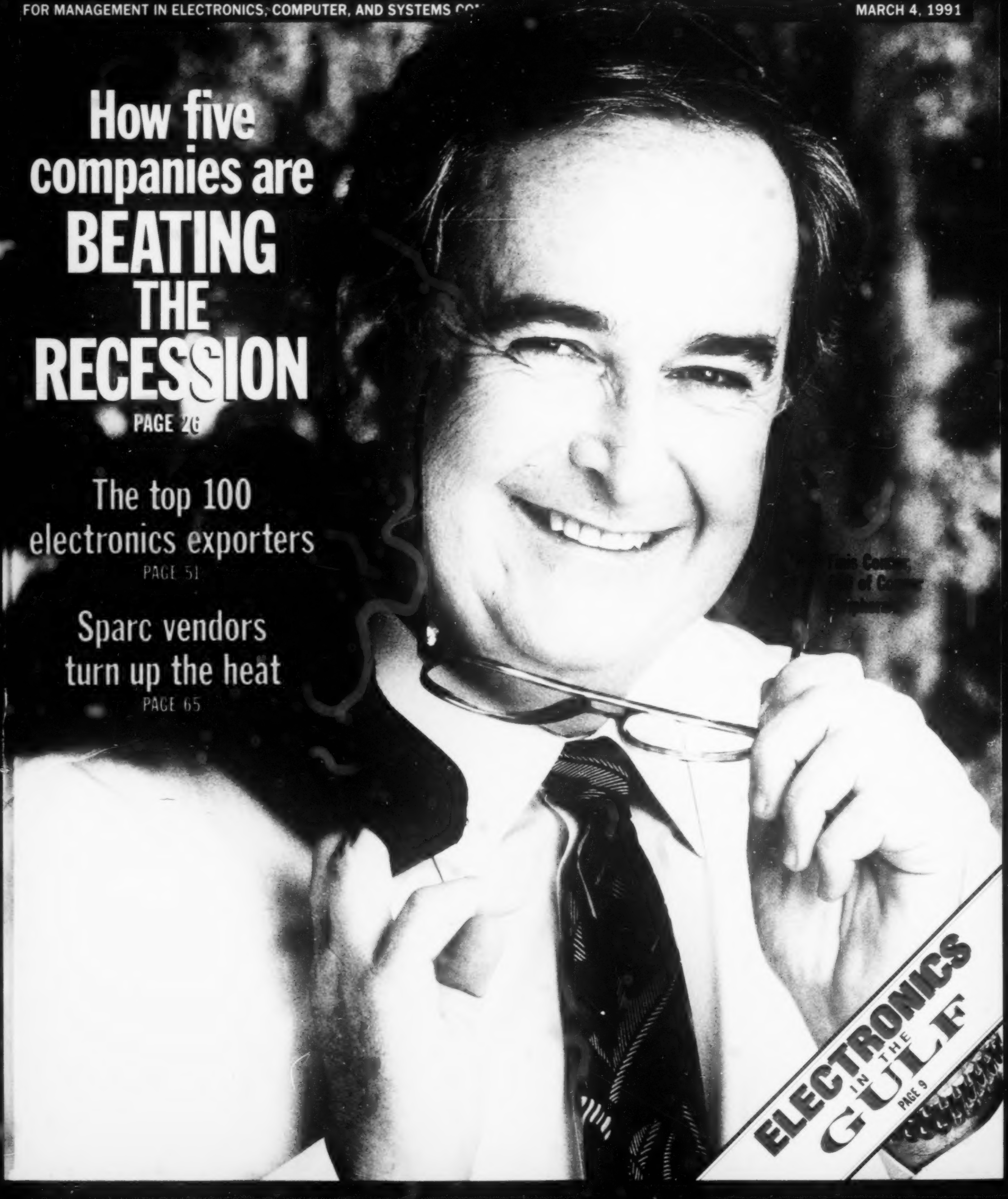

How five companies are BEATING THE RECESSION

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The top 100 electronics exporters

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Sparc vendors turn up the heat

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ELECTRONICS IN THE GULF

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Electronic Business

FOR MANAGEMENT IN ELECTRONICS, COMPUTER, AND SYSTEMS COMPANIES – WORLDWIDE

VOL. 17, NO. 5

MARCH 4, 1991

PAGE 26 **Conner Peripherals' founder Finis Conner scored big by teaming up with a major customer right from the start**

COVER STORY/BEATING THE RECESSION

26 How five companies are beating the recession

In just about every recession, it seems a few executives don't get the word. Against all odds and despite the economic downturn, five electronics companies in particular—Altera, Borland International, Conner Peripherals, Stratus Computer, and Xilinx—continue to be spectacularly profitable. Is it simple dumb luck, or are these companies doing something right?

Cover: Christopher Springmann

UPDATE

9 Electronics in the Gulf

Given the stunning accuracy of Allied weapons in the Gulf, you'd never know that many are being used for the very first time. Much of the credit goes to simulators that allow pilots to practice their missions before leaving the ground

15 Business Trends

Deals with Soviets prove disappointing; Analog adopts distribution policy; Computer Bowl sees East-West faceoff; start-up delivers PC image compression; DEC prognosis is better than expected; quality tops Marshall agenda; South Korean demand for components rises; flat semiconductor market for Italy; Ericsson's stake in Orbitel proves profitable; an industry giant is gone

COVER STORY/BEATING THE RECESSION

26 How five companies are beating the recession

For several months now, the U.S. electronics industry has been awash in pink slips and red ink. But some companies are laughing off the downturn and have managed to stay afloat. How are companies such as Altera, Borland International, Conner Peripherals, Stratus Computer, and Xilinx riding high while the competition is running for cover? In some cases, it's simply a matter of having the right product in the right place at the right time. But despite the negative environment that surrounds the industry, these five companies are holding their own and proving profitable in a tough market

STRATEGIES

34 Intergraph still defending its contrary ways

After 21 years of steady growth, Intergraph insists on going its own way. The Huntsville, Ala., CAE/CAD/CAM company has broken many of Wall Street's most hallowed rules by clinging to what some claim to be an outdated strategy based on proprietary turnkey systems. But billion-dollar Intergraph shows no signs of backing down. Maybe the company knows something the industry doesn't. Or maybe it's simply out of touch

MANAGING RESOURCES

45 Small suppliers join the ranks of U.S. exporters

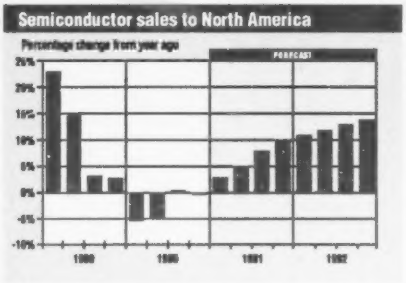
With sluggish domestic markets and a weakening dollar, international markets have taken on a certain allure for U.S. electronics companies. But for many would-be exporters, overseas expansion raises many more questions than it answers. A growing array of federal and state services, private consultants, and international representatives can make the decision a little easier

PAGE 45 "Most small companies are afraid to get started in international markets. They're afraid it will cost too much and they won't get paid," says Bart Hazleton, president of Bison Instruments

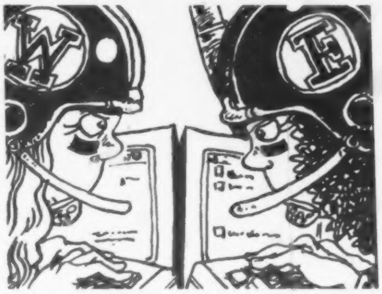
PAGE 34 Intergraph's CEO James Meadlock: Four years later and still profitable

PAGE 65 Sun's Bill Keating: "It is a fatal mistake for Sparc vendors to compete head-on with Sun on price"

PAGE 61 Motorola's C. D. Tam says Hong Kong's government now knows that laissez faire won't work



PAGE 74 Semiconductor sales expected to rise



PAGE 15 East meets West in Computer Bowl

MANAGING RESOURCES

51 Electronics exports boost the U.S. bottom line in 1989

The surge of overseas sales by U.S. companies has helped close the trade gap, according to ELECTRONIC BUSINESS' exclusive survey of the top 100 U.S. electronics exporters. But the accelerating move to offshore production could result in a somewhat different story by this time next year

EUROPE BUSINESS

57 Sagging profits spark identity crisis at Nokia

Oy Nokia, Finland's top electronics company, may be in trouble. Among the company's four core businesses, only telecommunications and mobile phones are profitable; consumer electronics and computers are less optimistic. Nokia now must slash its costs, develop new outlets, and identify its role in the global electronics market

ASIA/PACIFIC BUSINESS

61 Hong Kong in 1997: What if it works?

In just six years, Hong Kong is scheduled to be repatriated to mainland China. In the meantime government, business, and technology leaders are doing everything they can to ensure that the nation takes its place as one of the Pacific Rim's most powerful electronics competitors

MARKET PERSPECTIVES

65 Fueled by new software, Sparc vendors turn up the heat

Three years ago, Sun took a gamble with its Sparc-based systems. Now, apparently, the risk is paying off, and Sun is ready to take on the competitors who plan to go head-to-head on price. Given Sun's resources, predicts a company source, it will be an uphill battle

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Semiconductors expect higher growth in '91

75 **Leading Indicator**
Despite the recent downturn, slow growth is expected

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Lessons in beating the odds

It's always fun to hear about someone who is beating the odds. Maybe it's the 45-year-old mother of four who finally picks up her college degree after 20 years of night school. Or it's the company that scores big in a depressed market while the competition is scrambling for shelter.

Take Intergraph. By Wall Street's reckoning, writes associate editor Peter Burrows, this supplier of CAD/CAM/CAE systems should have gone belly-up years ago. Not only does the company sit in splendid isolation in Huntsville, Ala., but CEO James Meadlock insists on a proprietary turnkey approach that everyone in the business describes as a death sentence.

Everyone, that is, except Intergraph and its customers. While Meadlock's strategy may seem outdated—even suicidal—in this era of open systems, the contrarian CEO is clearly doing *something* right: Intergraph has never had a losing quarter, enjoyed a 6% profit margin last year (beating out such favorites as Sun Microsystems), and is the world's only billion dollar company dedicated to CAD/CAM/CAE systems.

Hundreds of other companies prove there's more than one way to stack the deck when times are tough. As proof, don't miss senior editor Linda Stallmann's exclusive report on the top 100 U.S. electronics exporters. Working with obscure data (often disguised under cryptic headings in corporate annual reports), Linda's findings demonstrate that hard times at home often spell juicy opportunities abroad: Total 1989 exports by the top 100 rose 19% from the previous year, while total sales climbed by only 9%.

Senior editor Linda Stallmann

Then there are those companies that seem to have a hard time explaining just *why* they are riding high while so many competitors are on the skids. Contributing editor Nancy Rutter takes a look at this phenomenon in "How five companies are beating the recession."

Some of these companies appear to be doing well by design. Borland International's focus on technology leadership, for example, has helped the company turn a $6 million deficit into a $6 million profit in just two years. But for other companies—such as Stratus Computer, the pioneer of fault-tolerant online computing technology—success appears to be a matter of having the right product in the right place at the right time.

All in all, we think, a timely topic given the dark economic picture being painted for 1991. We hope you'll spend a little extra time with this issue of ELECTRONICS BUSINESS. Odds are you'll pick up more than a few tips on running your company smarter and more profitably.

H. GARRETT DeYOUNG, managing editor

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BPA ABP

Simulators win their wings in the Gulf

In the early days of the Vietnam War, pilots of Air Force F-105s were shot down over North Vietnam with tragic frequency. Because the planes were equipped with an early version of terrain-following radar that could spot enemy antiaircraft installations from afar, it was thought the planes could handle low-level missions to knock out hard-to-hit targets. But pilots lacked the practical training to read and react to the radar in the seconds it took before they flew into unfriendly skies.

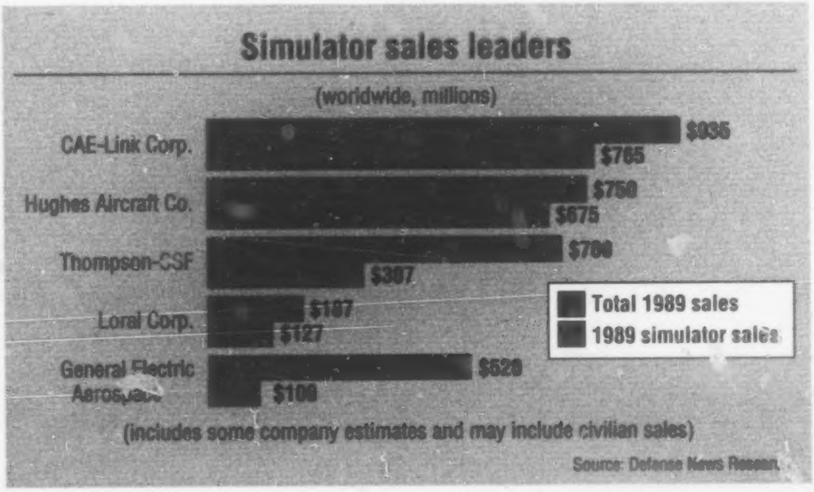
"Pilots came back screaming for training," says Jack Bradish, manager of strategy with Hughes Flight Simulation Operations in Herndon, Va. "You are already in mental overload when you're up there, and your reactions have to be automatic." Training came in the form of a simulated cockpit; losses soon plummeted.

Almost two decades later, the military world seems to have recognized the value of simulators. From four-story $40 million behemoths to mobile, PC-based battlefield systems, military simulators made up a $1.09 billion business in 1990, according to New York-based Frost & Sullivan Inc. Growth has been brisk for contractors such as market leader CAE-Link Corp. in Binghamton, N.Y., General Electric Co.'s aerospace division in King of Prussia, Pa., and hardware vendors such as Evans & Sutherland Corp. in Salt Lake City and Encore Computer Corp. in Ft. Lauderdale, Fla.

The payoff can be clearly seen in the Persian Gulf. Airmen, who may have fired no more than one real missile in years of training, struck Iraqi targets with surgical accuracy. Patriot missile launchers, who had never actually fired one of the $500,000-plus devices, consistently knocked Scud missiles out of the sky. Electronic jamming and surveillance systems, never used in combat, were employed with stunning precision.

The electronics industry can claim much of the credit for the improved effectiveness of simulators. Instead of "flying" over cardboard landscapes, simulator pilots now fly over vast software-created areas. Rather than practice one's skills in a static setting, instructors now make use of burgeoning computer power and database technology to throw a myriad of problems at trainees—including engine problems, bad weather, wind shear, and even enemy fire.

Sitting in the cockpit of such a simulator is no day at the arcade. In a typical aircraft simulator, trainees wear "G" suits that simulate the affects of gravity during maneuvers at supersonic speed. Synthesizers mimic the roar of the wind and the scream of departing missiles. Some systems sit on motion platforms that try to duplicate the turbulence of combat.


Simulator sales leaders

(worldwide, millions)

(includes some company estimates and may include civilian sales)

Source: Defense News Resear

Lessons from the Gulf

But simulation is going beyond just the teaching of individual skills. Various projects have made it possible to link groups of simulators to more accurately recreate the complex coordination needed in wartime. At the Army base in Ft. Knox, Ky., up to 80 tanks can "run" missions together through a DARPA-devised link called SIMNET. Another Army program in Ft. Rucker, Ala., lets teams of various helicopters face off in highly realistic war games.

Given the remarkable coordination of the Allied attack in the early weeks of the Gulf war, some say the dividends of these efforts are already with us. One achievement, called "mission rehearsal," may prove especially invaluable. By downloading worldwide weather forecasts and satellite reconnaissance into specially equipped simulators, pilots reportedly have been able to run through missions hours before taking to the air.

Pilots are not the only beneficiaries of simulation; the nation benefits as well. Because of the prohibitive price, range, and destructiveness of today's weapon systems, simulation has become a critical means to test, analyze, and define the nation's defenses. "We are not only in the business of saving lives but also of saving money and the environment," says Bradish.

But simulation has not been immune to military cost cutting. Sales of simulation equipment and services by U.S. Department of Defense prime contractors fell from a high of $1.82 billion in 1985 to $1.09 billion in 1989, Frost & Sullivan reports.

Spending on military simulators should continue to dip for the next few years, as resources are diverted to pay for the war and to refurbish the national arsenal. But most observers expect the segment to outpace the rest of the defense industry after that. "As you reduce the size of your military budget, it becomes even more important that all your troops are well trained," notes retired General Robert Reed, now executive director of the National Training Systems Association in Arlington, Va.

PETER BURROWS

EXPORTS

Electronics exports boosted the U.S. bottom line in 1989

A surge in offshore sales by U.S. companies helped close the trade gap, but foreign production could slow the pace of exports

BY ELIZABETH B. BAATZ

Despite the negative impact of a strengthening dollar, 1989 shipments by the top 100 U.S. electronics exporters rose 19% above 1988 levels, while total electronics sales by those companies grew just 9%. According to an exclusive ELECTRONIC BUSINESS survey, those 100 companies exported $33.4 billion worth of products in 1989—nearly 21% of all domestic and foreign electronics sales.

Not surprisingly, the largest companies contributed the most to the gain. The five largest U.S. electronics exporters shipped $14.4 billion of products and services, accounting for 43% of the total value of exports; together, the top 10 contributed 59% of the total value.

The ELECTRONIC BUSINESS survey of exports is limited to U.S. companies that derive at least 50% of their revenue from electronics. Exports include both direct sales to foreign customers and intracompany transfers to non-U.S. operations. U.S. sales are direct sales to U.S. customers from U.S. sites plus exports from U.S. sites.

IBM topped the list of leading U.S. electronics exporters with $5.5 billion in overseas sales, or 16% of electronics exports by the top 100. Hewlett-Packard, Motorola, and Digital Equipment each exported more than $2 billion in 1989.

The survey also identified the fastest-growing exporters. Top honors went to Sensormatic Electronics Corp. of Deerfield Beach, Fla., a producer of security systems for retail and industrial markets. Sensormatic exports rose more than 400%, from $9.2 million in 1988 to $48 million in 1989, thanks largely to the company's new Singapore subsidiary and expanded Far East distribution and procurement networks. Conner Peripherals Inc. of San Jose ranked second among the fastest-growing exporters with a 322% gain, due to inroads into Japan. Computer and systems makers Dell Computer, Concurrent Computer, and Teradata rounded out the five fastest-growing exporters.

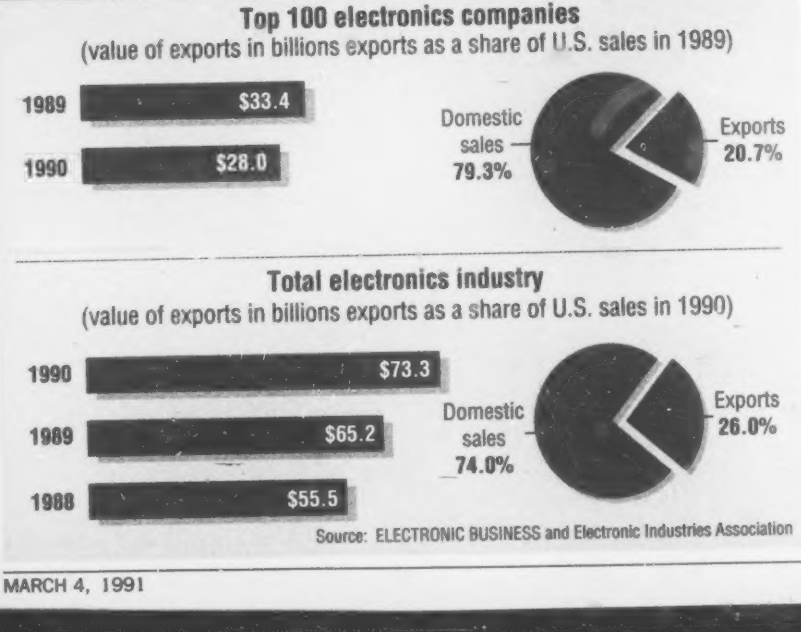
Interestingly, some companies pulled back on exports during 1989. Exports by Micropolis Corp. in Chatsworth, Calif., for example, fell by nearly 50%. At the same time, Tandon cut back by 38%.

As a share of U.S. sales, Atari Corp. was tops with 88% of all U.S. sales making their way abroad. (The figure is deceptive, however, since Atari's exports are counted after the company imports product into the U.S. from its production facilities in the Far East.) Other companies whose exports ran more than 50% of their U.S. sales include Tandon, Datapoint, Burr-Brown, Measurex, and Chips and Technologies.

Future export patterns are far from clear. Despite nationalistic concerns in Washington and throughout industry, top U.S. electronics companies are moving their production closer to their foreign customers, and that could alter their export data. Tandon Corp., for example, shipped exports worth 64% of its U.S. sales in 1989. Late that year, however, the company transferred its production from California to Vienna and now produces almost all the products it sells to Europe in Europe. ☐

Senior editor Linda Stallmann and assistant editor Xiong Xiaoge contributed to this report.

Electronics exports at a glance


Top 100 electronics companies

(value of exports in billions exports as a share of U.S. sales in 1989)

Total electronics industry

(value of exports in billions exports as a share of U.S. sales in 1990)

Source: ELECTRONIC BUSINESS and Electronic Industries Association

Top 100 electronics exporters

Rank	Company	1990 Exports ($ millions)	% change	1990 Exports as a % of U.S. sales	Rank	1989 Exports as a % of U.S. sales	Rank	1990 U.S. sales ($ millions)	1990 Total sales ($ millions)	ELECTRONIC BUSINESS 200 Rank
1	**IBM**	$5,476.0	10.6%	17.5%	73	16.4%	65	$31,221	$62,710	1
2	**Hewlett-Packard**	2,634.0	27.6%	32.1%	34	30.2%	30	8,195	11,899	5
3	**Motorola**	2,319.0	33.1%	28.5%	44	24.8%	45	8,123	9,620	8
4	**Digital Equipment**	2,103.3	4.2%	26.4%	49	25.8%	43	7,952	12,742	3
5	**Unisys**	1,906.5	-5.3%	27.1%	48	27.3%	38	7,043	10,097	7
6	**GM Hughes**	1,530.4	10.2%	13.5%	84	12.3%	83	11,359	11,359	6
7	**Raytheon**	1,340.0	2.5%	16.3%	78	17.2%	62	8,215	8,796	14
8	**Intel**	997.9	7.8%	36.0%	23	36.1%	14	2,773	3,127	23
9	**Compaq**	796.9	47.3%	33.7%	29	29.9%	31	2,367	2,876	27
10	**Xerox**	770.0	93.0%	6.3%	96	3.6%	99	12,312	17,635	4
11	**Sun Microsystems**	751.0	99.1%	42.5%	12	36.8%	13	1,765	1,765	39
12	**Apple**	558.3	34.1%	16.4%	77	15.0%	70	3,401	5,284	13
13	**NCR**	483.0	6.6%	16.5%	76	15.5%	67	2,925	5,956	12
14	**Control Data**	460.0	-9.6%	15.9%	80	14.2%	78	2,897	2,935	24
15	**Tektronix**	458.1	19.4%	37.4%	17	32.9%	20	1,226	1,433	47
16	**Atari**	449.6	18.7%	88.2%	1	76.2%	2	510	424	100
17	**Tandem Computers**	421.3	30.5%	34.9%	26	33.4%	18	1,208	1,633	41
18	**Amdahl**	414.6	61.1%	27.8%	47	20.1%	57	1,491	2,101	38
19	**National Semiconductor**	405.9	31.9%	30.9%	38	27.8%	36	1,314	1,648	43
20	**Varian Associates**	402.0	21.8%	33.1%	32	32.0%	23	1,214	1,344	48
21	**Conner Peripherals**	388.2	321.6%	49.0%	9	31.4%	25	792	705	73
22	**Advanced Micro Devices**	362.5	-35.5%	38.7%	15	46.6%	7	936	1,105	57
23	**Wang Laboratories**	332.1	33.9%	19.2%	68	14.2%	77	1,734	2,869	31
24	**Data General**	290.8	5.7%	30.1%	39	27.2%	39	967	1,314	51
25	**Texas Instruments**	272.0	2.3%	5.7%	98	5.7%	93	4,747	6,522	10
26	**General Instrument**	252.7	21.2%	19.2%	67	16.8%	63	1,317	1,377	49
27	**Intergraph**	243.2	10.2%	34.8%	27	32.6%	22	699	860	69
28	**Cray Research**	239.2	16.0%	33.0%	33	29.4%	33	724	785	71
29	**Western Digital**	236.6	88.3%	38.3%	16	33.3%	19	618	992	60
30	**AMP**	234.7	34.3%	15.5%	81	12.5%	82	1,517	2,797	33
31	**Honeywell**	220.6	14.7%	4.8%	100	4.4%	96	4,568	6,059	11
32	**Teradyne**	217.1	2.8%	44.9%	10	45.7%	9	484	484	87
33	**Microsoft**	214.0	49.5%	36.9%	19	31.7%	24	579	804	61
34	**Storage Technology**	204.6	38.1%	24.3%	56	19.8%	59	841	841	59
35	**Applied Materials**	191.9	41.8%	52.3%	8	45.8%	8	367	502	83
36	**Computer Associates**	181.8	47.7%	24.7%	54	23.7%	47	735	1,030	52
37	**Harris**	178.5	33.2%	9.2%	92	7.9%	90	1,936	2,214	30
38	**Foxboro**	172.0	27.0%	36.5%	21	33.8%	16	472	598	116
39	**E-Systems**	163.3	9.0%	10.0%	90	10.4%	84	1,626	1,626	46
40	**Novell**	146.6	35.6%	34.8%	28	31.2%	27	422	422	97
41	**Maxtor**	142.3	64.8%	33.6%	30	27.5%	37	423	351	93
42	**Loral**	137.9	23.4%	11.6%	88	9.8%	85	1,187	1,187	54
43	**3Com**	135.0	77.8%	36.2%	22	31.0%	28	373	386	104
44	**Wyse Technology**	134.4	22.9%	29.9%	40	24.0%	46	450	452	91
45	**Medtronic**	129.9	26.2%	23.1%	59	21.5%	55	562	742	75
46	**Gerber Scientific**	127.1	6.4%	42.5%	13	45.2%	10	299	299	134
47	**Tandon**	125.6	-37.9%	63.5%	2	83.6%	1	198	289	114
48	**Chips and Technologies**	124.0	56.6%	57.0%	6	56.0%	6	218	218	150
49	**Micron Technology**	117.4	24.6%	26.3%	50	31.4%	26	446	446	106
50	**Perkin-Elmer**	114.7	29.8%	23.3%	58	20.9%	56	493	784	74

(continued)

Top 100 electronics exporters

Rank	Company	1990 Exports ($ millions)	% change	1990 Exports as a % of U.S. sales	Rank	1989 Exports as a % of U.S. sales	Rank	1990 U.S. sales ($ millions)	1990 Total sales ($ millions)	ELECTRONIC BUSINESS 200 Rank
51	**Analog Devices**	$108.9	14.2%	32.0%	35	29.6%	32	$341	$453	92
52	**Scientific-Atlanta**	107.3	46.8%	19.6%	66	14.4%	75	547	547	79
53	**Symbol Technologies**	99.3	NA	53.0%	7	NA	—	187	222	170
54	**Ast Research**	90.5	40.3%	21.0%	65	16.5%	64	430	457	88
55	**Silicon Graphics**	89.4	112.8%	35.9%	24	28.7%	34	249	264	122
56	**Watkins-Johnson**	88.6	35.5%	41.8%	14	30.3%	29	212	311	129
57	**VLSI Technology**	87.2	82.4%	33.5%	31	23.5%	46	261	288	138
58	**Stratus Computer**	78.6	48.7%	25.4%	52	21.7%	54	309	341	123
59	**Burr-Brown**	77.1	-0.4%	58.8%	4	58.7%	4	131	169	197
60	**MAI Basic Four**	70.8	-14.1%	29.5%	42	34.2%	15	240	397	112
61	**Westmark International**	70.6	46.4%	18.2%	71	15.6%	66	388	439	95
62	**Sprague Technologies**	70.0	-13.6%	28.5%	45	28.2%	35	245	344	121
63	**Datapoint**	68.5	-21.3%	60.6%	3	62.9%	3	113	313	142
64	**Oracle**	67.1	85.3%	18.2%	70	19.6%	60	369	584	72
65	**Quantum**	64.5	55.5%	31.0%	37	22.0%	52	208	208	109
66	**Dell Computer**	63.5	227.0%	17.4%	74	8.2%	89	364	389	111
67	**Measurex**	61.0	8.9%	58.2%	5	57.6%	5	105	285	141
68	**Andrew**	59.2	40.0%	25.6%	51	22.3%	51	232	302	125
69	**Diebold**	57.2	29.5%	12.2%	87	9.8%	86	469	469	108
70	**GenRad**	55.7	24.9%	37.0%	18	26.0%	42	151	189	188
71	**General DataComm**	53.7	100.0%	29.7%	41	15.2%	69	181	201	179
72	**Esterline**	52.5	-11.3%	23.6%	57	26.0%	41	222	284	165
73	**Archive**	50.8	65.6%	28.0%	46	25.0%	44	181	181	186
74	**International Rectifier**	50.8	18.5%	35.9%	25	33.5%	17	141	195	175
75	**Dynatech**	50.5	7.5%	14.9%	82	14.9%	72	339	400	103
76	**Genicom**	50.4	38.5%	21.0%	64	14.9%	71	240	257	153
77	**KLA Instruments**	49.9	26.6%	36.6%	20	41.0%	12	136	165	198
78	**Sensormatic Electronics**	48.0	423.4%	24.6%	55	9.0%	87	195	151	196
79	**Digital Communications**	46.4	-6.5%	22.3%	62	21.8%	53	208	208	174
80	**Cypress Semiconductor**	45.8	43.0%	23.0%	60	23.0%	49	199	199	181
81	**Coherent**	45.5	24.9%	28.7%	43	26.3%	40	158	202	182
82	**Vishay Intertechnology**	43.4	76.0%	18.1%	72	22.7%	50	239	416	102
83	**Integrated Device Tech.**	41.6	71.6%	23.0%	61	20.0%	58	181	181	178
84	**Intermec**	41.2	34.0%	31.4%	36	32.8%	21	131	131	199
85	**Kollmorgen**	41.1	6.5%	22.2%	63	18.7%	61	185	228	177
86	**M/A-Com**	40.6	19.4%	9.9%	91	8.8%	88	411	441	98
87	**Micropolis**	40.2	-49.6%	44.6%	11	42.1%	11	90	307	132
88	**Smith Corona**	36.3	57.8%	7.0%	95	5.7%	94	515	493	101
89	**Cubic**	35.1	118.0%	10.0%	89	4.7%	95	349	349	126
90	**SCI Systems**	35.0	45.8%	5.2%	99	4.3%	97	667	987	56
91	**Teradata**	32.7	139.2%	25.1%	53	15.5%	68	130	137	193
92	**Beckman**	32.5	68.4%	5.8%	97	3.8%	98	559	786	70
93	**ADC Telecommunications**	31.3	19.8%	15.9%	79	14.5%	73	196	196	173
94	**Everex Systems**	26.6	53.4%	8.0%	93	7.4%	91	334	377	107
95	**Recognition Equipment**	25.6	32.9%	19.1%	69	14.4%	74	134	256	159
96	**Tellabs**	23.5	13.9%	14.6%	83	13.9%	79	161	181	191
97	**Concurrent Computer**	23.4	148.1%	12.3%	85	14.3%	76	190	278	120
98	**Molex**	23.2	10.2%	12.2%	86	12.6%	81	190	572	80
99	**Ashton-Tate**	23.1	-16.5%	16.7%	75	12.9%	80	138	265	148
100	**Dataproducts**	20.8	10.1%	7.5%	94	7.2%	92	278	353	124
	Totals:	$33,404.7	19.2%	20.7%		18.8%		$161,071	$230,792	

NA = Not available

Fueled by new software, Sparc vendors turn up the heat

Sun's risky gamble in opening Sparc is paying off. New systems and software are boosting the market. But price wars could backfire

BY DAVE WEBB

Three years ago, Sun Microsystems Inc. made a bold announcement of a risky strategy: Sun would convert from conventional CISC microprocessors to its newly developed Scalable Processor Architecture (Sparc) RISC design.

The news was greeted with something less than hearty applause and respect. Could this brash company successfully market a novel system design? Could Sun then build a broadly accepted standard in the marketplace by licensing Sparc to anyone? The answer is that Sun could, and has, done so.

Today it's hard *not* to applaud that strategy. Demand for Sun's Sparc-based systems has taken off. With more than 200,000 installed systems to its credit, the Sparc design is the dominant architecture in the $6.8 billion worldwide RISC (reduced instruction set computer) systems market. Following the rapid proliferation of Sparc-compatible systems and application software, Sparc may even rub out the remaining thin share of computers based on CISC (complex instruction set computer) technology in the workstation market.

International Data Corp. estimates that U.S. vendors of RISC-based workstations and servers will generate $6.8 billion in worldwide revenue this year, up from $4 billion last year. In 1990, Sparc-based computers made up 55% of all RISC systems shipped, IDC estimates. While Sparc-based systems do not generate as high a per-unit revenue average as Mips Computer Systems Inc. and other RISC-based systems on the market, at least $2 billion of all RISC computer sales in 1990 can be attributed to Sparc, based on Sun's revenue. However, Sun was the only significant system shipper last year. And there is much more to come.

At least 30 Sparc-compatible system vendors have announced products to date, with a flurry of introductions at the Comdex and UniForum trade shows. Before the end of last year, the only Sparc-compatible vendors actually shipping were Solbourne Computer Inc. and Toshiba Corp. Solbourne shipped about 1,000 units, and Toshiba only a few hundred. Solbourne makes high-end multiprocessing workstation systems and Toshiba sells a Sparc-based portable.

Sparc has also found its way into computer systems other than workstations. Star Technologies Inc. and ICL plc, for example, are marketing Sparc-based servers. Opus Systems Inc. sells a Sparc subsystem for boosting the performance of a PC, while later this year Force Computers Inc. will begin manufacturing Sparc-based VMEbus and Futurebus computer boards for embedded systems applications.

Sun's Bill Keating: "It is a fatal mistake for Sparc vendors to compete head-on with Sun on price"

Anchoring the high end of the Sparc market will be the Sparc version of the Model 500 supercomputer, which FPS Computing in Beaverton, Ore., plans to debut this year. That will complete Sun president and CEO Scott McNealy's vision of a Sparc universe stretching from laptops to supercomputers.

Not only has the number of Sparc-compatible manufacturers grown dramatically in recent months, but a flood of Unix-based application software is broadening the user base. Independent software vendors now regard the once application-poor Unix environment as a legitimate general-purpose operating system. Their efforts will, in turn, feed the fire and increase the demand for hardware. Sun's open Sparc strategy has lit a fire among hardware and software makers.

The list of Sun-approved application software packages has zoomed to over 2,000. Sparc International, a Sunnyvale, Calif.-based association of hardware and software vendors, claims that software developers are lining up to generate applications well beyond the usual Unix base of engineering, technical, and scientific applications.

Sun itself is making noises about addressing the commercial systems market, now served primarily by mainframe and minicomputer manufacturers. Sun intends to encourage not only new applications such as point-of-purchase and inventory management, but also personal productivity applications that typify the huge PC market. Sun has made no bones that it would like to see Sparc

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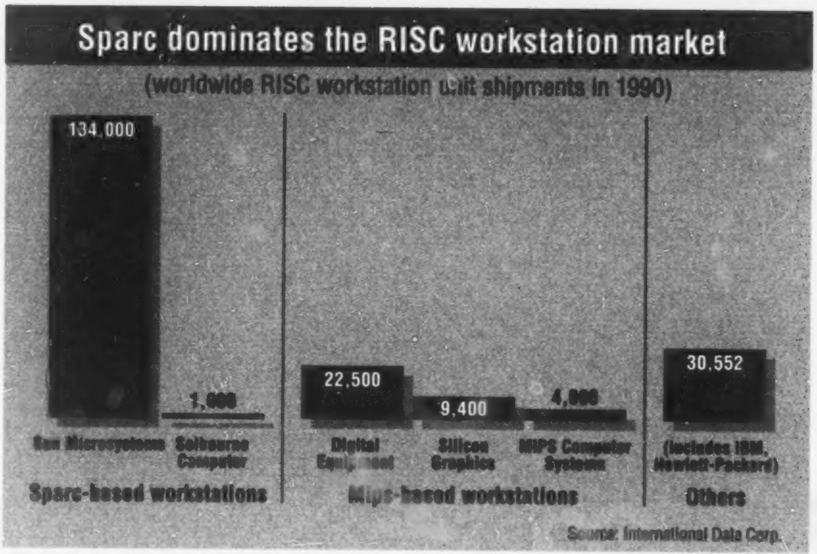
Sparc dominates the RISC workstation market

(worldwide RISC workstation unit shipments in 1990)

Source: International Data Corp.

as the microprocessor standard of the 1990s, much like Intel's CISC chips were in the '80s.

Sun's tactic is to build a large enough installed base to attract application developers into these new areas for Unix. "The real thing we are pushing now is to see an increase in the number of independent software vendors," says Bob Duncan, chairman of Sparc International, who adds that Sun is being "very aggressive" to that end.

Sun's open Sparc strategy has lit a fire among hardware and software makers

Sparc-compatible vendors are breaking new ground in niche application markets that may ultimately be targets for Sun. The market is following Sun's strategy, according to Bill Keating, the company's director of corporate technology. The strategy is to build a large installed base and then allow clone makers and independent software vendors to leverage that base to develop other application areas. Then Sun may move in on those areas.

"We are using the Sparc-compatible [vendors] to build a stronger market," Keating says. "As the installed base of systems grows, there is more demand for new applications and software developers. The more ISVs we get, the more applications—and users—we get. It all sort of feeds upon itself."

To help establish Sparc as the microprocessor architecture of the '90s, Sun needs a major PC manufacturer to incorporate it into future products. Because IBM has its own RISC microprocessor, observers say a decision by Compaq Computer Corp. to adopt a RISC architecture will be a bellwether for the industry. Lately, Compaq seems to be trying to decide between Sparc and competing RISC chips from Mips. One key factor could be Microsoft Corp. The software giant plans to adapt its MS-DOS and OS/2 operating systems to an unnamed RISC chip. Microsoft's choice could make or break Sparc's chances of becoming the undisputed RISC leader.

But the Sparc system vendors may have a tough time emulating Sun's success. Most of the Sparc-compatible system vendors are more or less cloning Sun's low-end systems. International Data Corp. analyst Vicki Brown says makers are copying Sun's SparcStation 1 and 1+ systems with the intent to beat Sun on price. But Sun is hard to beat.

Sun's Keating claims vendors will make a fatal mistake in going head to head on price with Sun. "If they don't add value, competing against Sun is just an uphill battle," Keating argues. The problem is that Sun has an excellent distribution and support

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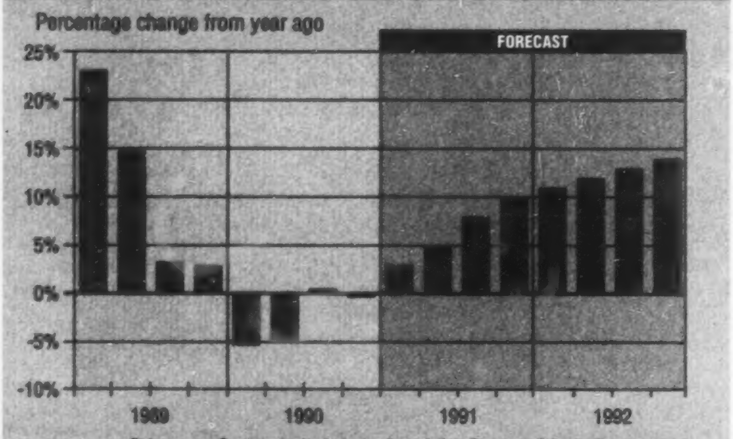
Executive Director

system in place. That relegates many of the me-too clone manufacturers—the ones aiming to market copies of Sun designs at lower prices—to channels that offer little, if any, technical support. Direct sales channels are costly and preclude competing on price with Sun.

"You are sort of caught between a rock and a hard place when it comes time to decide which channels to focus on," says Jay Prakesh, an industry analyst at Strategic Focus Inc. "You need a certain level of technical support for Unix, but can you afford to maintain it while competing on price? It is an issue that has yet to be resolved." That could drive several smaller Sparc vendors out of the market.

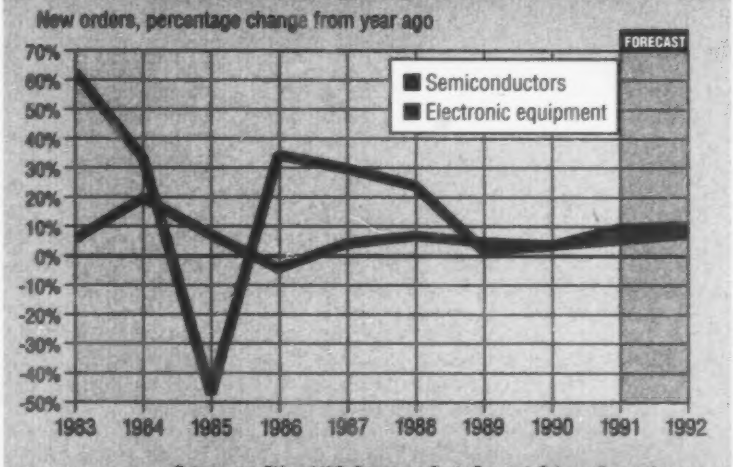
Solbourne is taking a different tack. "Solbourne is doing well due to its high level of service and support," says IDC's Brown. A few other companies, notably Mars Microsystems Inc. and Solarix Systems, are also trying a different path, targeting so-called "power DOS" users by coupling CISC coprocessors with Sparc chipsets. Such systems will run the huge array of shrink-wrapped DOS applications now available for PCs. "We were playing in a totally different market," says Mars co-founder Kevin Gonor, the company's vice president of sales and marketing. "We want to attack not just the workstation market but the desktop market as well. We want the user to run any DOS-based applications they had at 25 Megahertz plus be able to run the 2,100 software packages for Unix now available."

Nonetheless, Sparc still faces some potential obstacles. John Hime, vice president of marketing of Mips Computer Systems' system products group, is undaunted by Sparc's rise to workstation market dominance. "You have to consider Mips as having a much different strategy than Sun. Sun and Mips really play in different ballparks. I think in general [beyond the workstation market], we will address a much larger market," he says, predicting Mips could outpace Sun and its licensees by as much as a factor of 10, especially in the markets for embedded microprocessor control and high-end system applications. But for now Sun's Sparc strategy is paying off surprisingly well. ☐



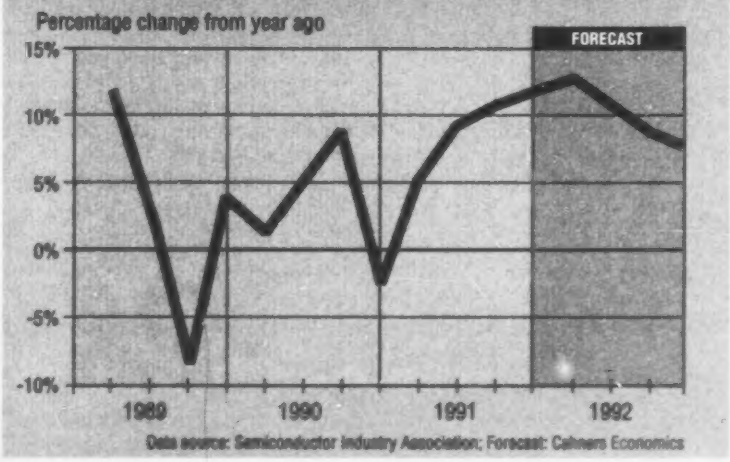
Semiconductor sales to North America

Data source: Semiconductor Industry Association: Forecast: Cahners Economics



Equipment orders drive semiconductors

Data source: SIA and U.S. Commerce Dept.; Forecast: Cahners Economics



Semiconductor bookings to North America

Data source: Semiconductor Industry Association; Forecast: Cahners Economics

Semiconductors expect higher growth in '91

The semiconductor industry remains weak, according to data from the Semiconductor Industry Association. Semiconductor sales to the North American market suffered two consecutive quarterly declines during the first half of 1990 and a 0.5% increase in the third quarter compared with the previous year; fourth-quarter sales dipped to $3.61 billion, 0.4% below the same period a year ago. For the twelve months ending in December, sales dropped 0.6% from the 1989 level, to $14.45 billion.

The sales dip is hardly good news for the industry. But if one compares the current industry downturn with the last electronics recession in 1985 (when sales plummeted 30% from the 1984 level), last year's 0.6% decline seems rather mild. And while fourth-quarter semiconductor orders recorded their first decline in a year (a 2.2% drop from a year ago), orders still managed to climb 3.4% for the entire year, to $14.95 billion.

It is still too early to tell how the Persian Gulf war will impact the semiconductor industry. Since the Iraqi invasion of Kuwait, however, new orders for electronic equipment have been shrinking, implying lower demand for semiconductor chips. Business confidence has also plunged and demand for all capital equipment has been weak since the invasion. Business confidence dropped from a peak of 65 in the third quarter of 1988 to a meager 24 in the final quarter of 1990, according to the Conference Board in New York. Economic uncertainty coupled with a weak economy clearly has caused many companies to put capital spending on hold.

Still, Cahners Economics believes that this year will bring better news to the semiconductor industry. Lower interest rates and stronger investment in high-tech capital equipment will help fuel demand for chips. As electronic end-markets pull themselves out of this period of sluggish growth, the semiconductor industry will start to see strong gains. Cahners Economics now forecasts that both semiconductor orders and sales will rise in every quarter this year, achieving double-digit gains in 1992. Our outlook calls for new orders for semiconductors to increase 9.4% to $16.4 billion this year and swell 10.3% in 1992. Similarly, sales will rise 6.6% to $15.5 billion this year and surge 12.6% to $17.5 billion in 1992.

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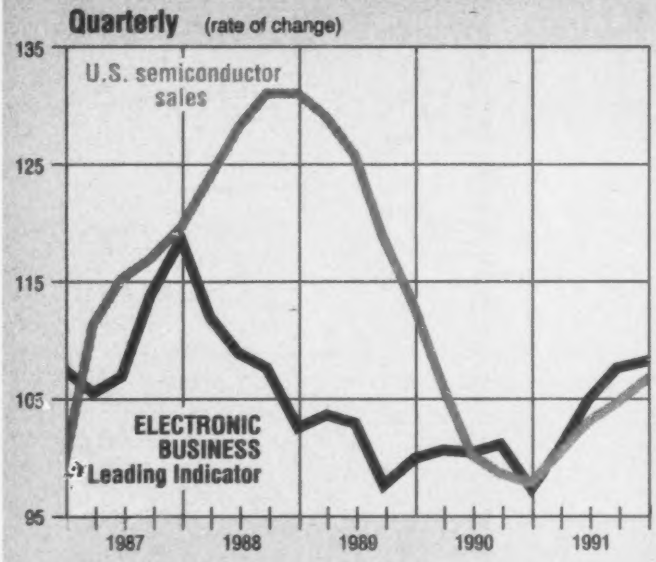
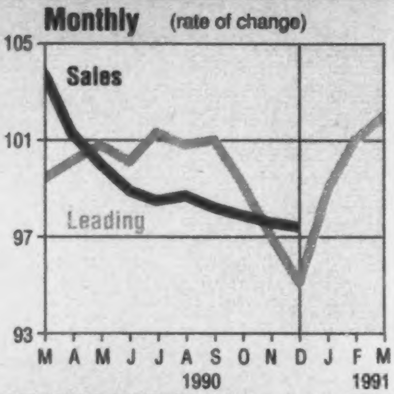


To obtain your complimentary copy of a backround paper on the ELECTRONIC BUSINESS Leading Indicator, please contact Linda Keehn, Cahners Economics, Cahners Publishing Co., 275 Washington St., Newton, MA 02158-1630 USA, telephone (617) 630-2119, fax (617) 630-2100.



The ELECTRONIC BUSINESS Leading Indicator (EBLI) dropped two points to 95.1 in December, dipping below the previous trough of 96.3 reached in September 1989. The EBLI was steadily rising from its previous low point, waffled in the first half of 1990, and reached a level of 101.3 in July. But after the August 2 invasion, an immediate downturn occurred, causing the indicator to veer off the path of our forecast. Once the uncertainty in the Gulf passes, the EBLI is anticipated to resume its slow growth pattern and will once again lead the activity of the electronics industry.

Source: Cahners Economics

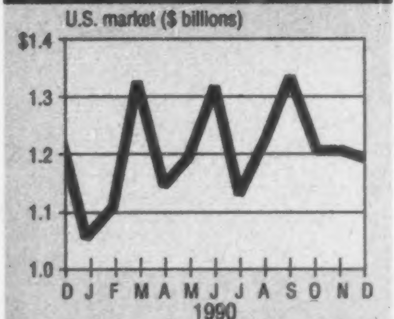
Electronics industry indicators this month

	Latest month	Previous month	Year ago	1989 average
ELECTRONIC BUSINESS Leading Indicator (rate of change, Dec.)	95.1	97.1	102.4	100.9
U.S. semiconductor bookings ($ millions, 3-month average, Dec.)	$1,157	$1,170	$1,183	$1,205
Weekly hours of semiconductor production workers (monthly average, Nov.)	40.6	40.0	41.1	40.1
Electronic components lead time index (1977 = 100, Jan.)	73.9	67.2	75.8	102.5
S&P's semiconductor stock price index (1970 =10, monthly average, Dec.)	57.4	54.9	57.9	54.7
Change in electronic components inventories ($ millions, SA, Nov.)	$52	$17	$27	-$12.8
Contracts and orders for plant and equipment ($ billions, SA, Nov.)	$39.5	$42.4	$43.9	$43.4

SA = seasonally adjusted, all other data are not seasonally adjusted

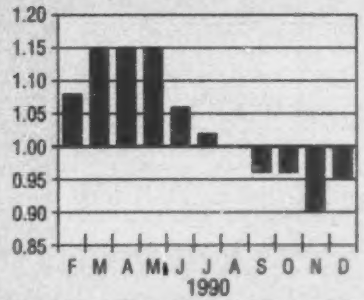
Sources: Semiconductor Industry Association, U.S. Bureau of Labor Statistics, *Electronics Purchasing* magazine, Standard & Poor's, U.S. Department of Commerce, U.S. Bureau of Economic Analysis

Semiconductor sales



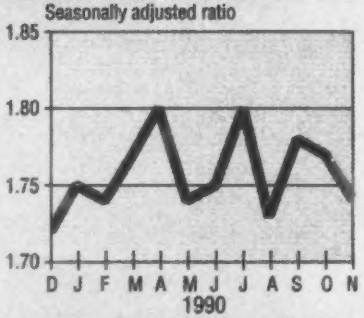
Source: Semiconductor Industry Association

Semiconductor book-to-bill ratio



Source: Semiconductor Industry Association

Component inventory-to-shipments



Source: U.S. Commerce Department

Report from Brussels ■ Embedded microprocessors

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MARCH 18, 1991

THE CEO AGENDA

Second Annual Exclusive Survey of Chief Executives by Electronic Business and Ernst & Young

Worldwide, business has never been tougher.
Top priorities for U.S. electronics executives:

✓ Devise winning strategies
✓ Search for new opportunities
✓ Empower the workforce
✓ Compete on a global scale
✓ Acquire key technologies
✓ Redefine the organization

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Electronic Business
FOR MANAGEMENT IN ELECTRONICS, COMPUTER, AND SYSTEMS COMPANIES—WORLDWIDE
VOL. 17, NO. 6
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THE CEO AGENDA

Second Annual Exclusive Survey of Chief Executives by Electronic Business and Ernst & Young

PAGE 34 According to the 1991 CEO survey, top electronics executives take a dim view of their industry's future

COVER STORY/CEO SURVEY

34 Writing an agenda for the 1990s

In the second annual ELECTRONIC BUSINESS CEO survey—a joint project with the consulting firm of Ernst & Young—we zero in on the problems facing top electronics executives in today's shaky world marketplace. Stiffening competition, rapid technological change, and organizational tactics are just some of the topics discussed by nearly 600 top executives. In-depth interviews and survey results provide insight into the future of the electronics industry

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Electronics industry gets some good news from the federal budget; worldwide electronics market to hit $1 trillion; Microsoft optimistic about Windows and OS/2; computer sales take another tumble; mail order sets the pace in home-office sales; videoconferencing provides alternative to air travel; company goes Hawaiian to boost worker morale

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Is hardware outpacing the software market and is one driven by the other? Will Fastie offers his view

COVER STORY/CEO SURVEY

34 Writing an agenda for the 1990s

There is one message that comes out of our second annual CEO survey: The market has been redefined by slower growth and maturing products. And while superior technology alone all but guaranteed success a few years ago, today it's simply the price of playing the game. The survey examines these and other challenges and studies how top executives are responding to them

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While innovation, product quality, and customer satisfaction are recognized as essential to the competitive company of the 1990s, CEOs concede they still lag their foreign rivals in the battle for global market share. Some companies claim to be fighting back by paying more attention to the customer at every stage of the design process

COVER STORY/CEO SURVEY

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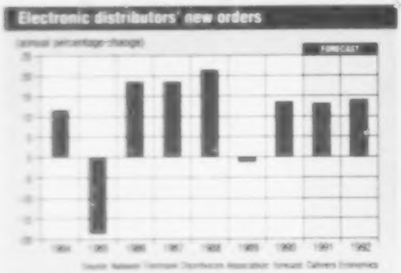
According to the survey, technological innovation is the most critical issue for maintaining competitiveness. Still, half of the CEOs agree that the United States is rapidly losing its technological edge, and almost as many see the picture getting even worse by 1995. The reason: Shrinking R&D spending could end the era of technological breakthroughs

60 The changing face of the organization

There is no single answer to guarantee an exceptional organization. But many believe that customer satisfaction and a total commitment to quality are the starting points in creating a first-rate company. Just as important are well-educated, highly motivated employees who aren't afraid to challenge the status quo

PAGE 89 "The lack of a home market is a massive disadvantage," says Terry Kelly, managing director of KEL Aerospace



PAGE 106 1990 was a good year for distribution orders

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As European electronics producers watch their share of the domestic market dwindle, a major policy paper to be released this month by the European Community may help revive the industry's competitiveness. Here are some of the men who hope to play pivotal roles in putting European electronics back in the international game

ASIA/PACIFIC BUSINESS

89 Downturn slows computer business down under

A sagging economy and the virtual lack of a domestic market are just two reasons why Australia's electronics industry has hit the skids. The federal government's Partnership for Development Program is one attempt to help electronics companies get back on their feet, but most analysts claim the government can and should do much more

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A close-up look at your competition

How often have you wished you could get inside the heads of your competitors for just a few minutes? What would it be worth to you to find out about these men and women's strategies—not just their plans to get through the next few years, but how they are laying the foundations that will assure their companies' growth and prosperity well into the 21st century?

Senior editor Elizabeth B. Baatz: A baptism by fire

That, in effect, is what the editors of ELECTRONIC BUSINESS did in producing our second annual CEO survey. Using surveys, roundtable discussions, and personal interviews, senior editor Elizabeth B. Baatz and contributing editor Bruce C. P. Rayner teamed up with Ernst & Young's high technology practice to explore the minds of nearly 600 top electronics executives.

The exercise was a sort of baptism by fire for Elizabeth, who joined our editorial staff just as the responses were pouring in. An economics graduate of Trinity College, Elizabeth is a former researcher with Data Resources Inc. and Cahners Economics, the research and forecasting arm of Cahners Publishing. Elizabeth barely had time to move into her new office before being swamped by the task of converting the thousands of raw data points into coherent copy.

Specifically, CEOs and other top executives talked about their industry and their companies from three perspectives—competitiveness, technological innovation, and organizational structure—and then elaborated upon how each of these factors have an impact on U.S. companies' standing on the world electronics scene.

The news isn't good. With a few exceptions, we didn't like what we found out, and chances are you won't either. While executives try to have a rosy outlook of the U.S. electronics industry over the next few years, it seems that there isn't a lot to be optimistic about.

Most executives pay lip service to the idea of competing through globalization, for example, but a whopping 93% of the industry's 1990 capital budget is pegged to domestic facilities, not overseas expansion. While more than half of our respondents cited first-rate technology as the sine qua non of today's successful electronics company, 40% predict a decline in U.S. technology during the next five years. And although product quality is seen as a hallmark of organizational excellence, only a handful of companies have set out for the Malcolm Baldrige National Quality Award.

"Every CEO worships at the altar of customer satisfaction and product quality," says Baatz. "But more electronics companies need to move from prayer to actually *doing* something . . ."

H. GARRETT DeYOUNG, managing editor

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will rise 7.7% in 1991, following two years during which growth came in at less than 3%. Henderson argues that the U.S. computer industry has suffered in the past 24 months from a lack of product vitality. He expects a boom of new hardware and software introductions to help PC, workstation, notebook, and mainframe makers counteract the effects of an economy-wide recession.

Maddy Franchi, an economist with Cahners Economics (ELECTRONIC BUSINESS's forecasting unit), also thinks 1991 will be better than 1990 for computer makers. She predicts computer and office equipment shipments will increase 4.4% this year, twice as fast as in 1990. Although optimistic, Franchi's forecast has been downgraded because of the war. "The recovery that was in the making prior to the Gulf crisis is now at a standstill," she says. "Computer employment is at its lowest level since 1980, PC delivery times have fallen, and computer prices continue to erode." Her optimism for 1991 is based on the prospects for lower interest rates, growing exports, and balanced inventories.

The forecasts for computers depend heavily on the willingness of businesses to invest in upgraded equipment. If investment plans are scaled back because of the war, computer makers could be saddled with another year like 1989. For many computer employees, that means the threat of a pink slip won't go away soon.

ELIZABETH B. BAATZ

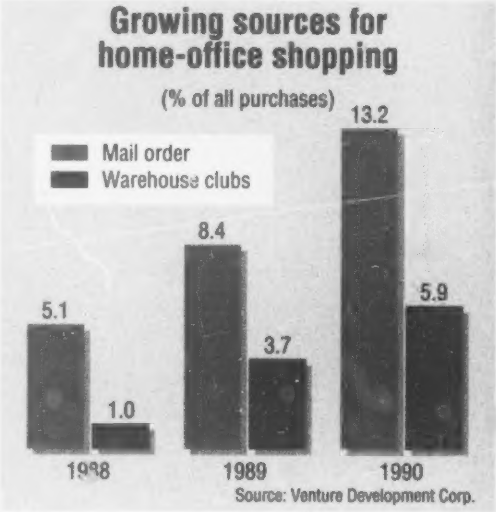
HOME OFFICE

Home-office buyers moving to mail order

SAVVY home-office workers are relying more and more on factory-direct mail-order companies when it comes to shopping for their phones, faxes, and PC equipment, but there is still hope for retailers in the home-office electronics market.

Since 1988, sales by mail-order companies and warehouse clubs have grown at annual rates of 56% and 143%, respectively, says vice president Marc Regberg at Venture Development Corp. in Natick, Mass. The big reason: lower prices. A full 70% of home-office workers told VDC pricing was the most important criterion in future purchases.

But that doesn't mean these customers are settling for cut-rate quality. "These are very technologically sophisticated shoppers," says Regberg. Nor does the issue of service give retailers much of an advantage, says VDC analyst Keith Kuzmin. There are few differences in service from retailer to mail-order, he says, since most retail chains provide little direct customer support; most buyers wind up going to the manufacturer with technical questions or paying extra for third-party extended warranty contracts. Besides, mail-order customers have the same OEM warranty coverage as retail customers, and some mail-order companies offer their own telephone technical support services.



Growing sources for home-office shopping

(% of all purchases)

Source: Venture Development Corp.

In addition to offering lower prices, mail-order companies are functioning on lower profit margins. According to VDC, the average gross margin on a fax machine is 14% for mail-order companies and catalog showrooms, versus 20% for mass merchants, 25% for office-equipment dealers, and 27% for consumer electronics stores.

One successful home-office direct marketer is Hello Direct, a San Jose-based vendor of business telephone accessories. The company introduced its catalog in 1988, and although president Allen Batts won't give exact sales figures, he says Hello Direct more than doubled its revenue from 1989 to 1990.

And that's in a sluggish market. The Electronic Industries Association says revenue growth for telephone accessories has actually declined since 1988, when sales peaked at $270 million. Batts attributes Hello Direct's success in part to its decision to market products strictly as business productivity tools for home-office workers and small companies.

Speaking of telephones, AT&T is no slouch when it comes to direct marketing to the home office. Ma Bell puts out a newsletter directed to home-office users, along with an 800 number for technical support and questions. Users can buy products directly through an AT&T catalog.

Regberg's warnings drew concern from retailers at the recent Consumer Electronics Show in Las Vegas, where he spoke on the home-office outlook. "Ultimately it's the retailer that gets hurt," he said. "But are they doomed to oblivion? No."

Retailers should realize that in the home-office market they are dealing with a very select group of consumers. If they choose to court those consumers, said Regberg, they could fight back by launching their own mail-order line. One cost-effective technique might be to work with their own equipment vendors, using warranty information to assemble a database of potential customers.

One thing that hasn't worked so well for mail-order companies is the opening of their own showrooms. "The showroom is starting to lose money for these guys," says Regberg. "Some who tried to do both are in trouble."

JOHN PARKER

PRODUCTION COSTS

Smarter buying cuts materials costs

TWENTY U.S. manufacturers, including some of the nation's top electronics companies, have cut materials costs by as much as 30% through long-term pacts with suppliers and improving design techniques.

That was the finding of a study by

Second Annual Exclusive Survey of Chief Executives by Electronic Business and Ernst & Young

THE CEO AGENDA

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Threatened by stiffening competition, rapid technological change, and a waning infrastructure, what are CEOs' strategies for survival? Top executives from nearly 600 companies addressed this and many more issues in the second annual ELECTRONIC BUSINESS/Ernst & Young CEO survey. In-depth interviews and survey data provide insights into the health and future prospects for U.S. electronics and computer companies

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What makes them tick, and other insights into today's CEO

The electronics CEO knows that reacting to change is no longer good enough. Instead, this breed of executive insists on setting the rules and the pace of today's competitive climate

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Competition is intensifying, and more CEOs than ever are gearing up to compete against Japan and Europe by 1995. What are they doing now to prepare for the race?

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This year's survey provides a wealth of data (revenue trends, funding, and market segmentation) on the U.S. electronics industry of the 1990s

Writing an agenda for the 1990s

BY BRUCE C.P. RAYNER

Electronics CEOs are grappling with some tough questions. Their answers will set the tone for the industry for years to come

The U.S. electronics industry has entered a new era. Slower growth, maturing markets, internationalization, and tough customer demands have redefined the marketplace. For the last few years, U.S. electronics executives have been facing up to this new competitive environment and writing new agendas for their companies. But as this year's ELECTRONIC BUSINESS/Ernst & Young CEO survey indicates, there is still much work to be done.

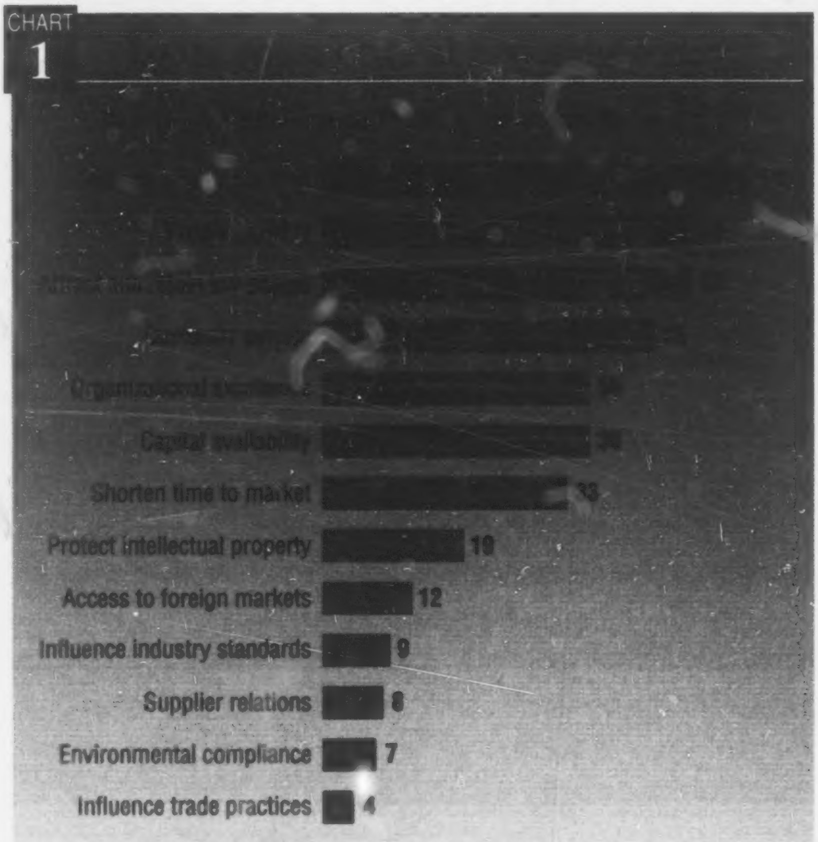
The second annual CEO survey of the U.S. electronics industry examines the challenges facing the industry and the strategic thinking of its chief executives. The survey looks beyond the buzzwords at how the trends are shaping the industry and how industry leaders are responding. It describes the actions industry leaders are taking to move ahead of the pack in the years to come.

The survey draws on data collected from a detailed eight-page questionnaire completed by nearly 600 CEOs in all major segments of electronics. In addition, ELECTRONIC BUSINESS editors consulted CEOs from large and small companies to discuss their companies' strategies. The combination of data and commentary is, in a sense, a reality check for those in the trenches.

This article explores the key findings of the survey and thereby lays the foundation for the report. The three articles that follow focus on the CEOs' responses to three compelling issues: maintaining a technological edge, adapting to the ever-intensifying competitive marketplace, and redesigning the organization for the 1990s.

Technology has always driven the electronics industry, and it is clear that technology will shape the industry for years to come. Whether evolu-

CHART 1



(Percentage of respondents; multiple responses possible)

tionary or revolutionary, technology defines the market and all of the players. It is thus not surprising that most CEOs regard technological innovation as today's most critical issue for maintaining a competitive edge in the market. This view is held by executives in almost all segments of the industry and in companies of virtually every size.

But executives realize that technology alone no longer satisfies the customer; it is simply the price of getting into the game. The question arises that if every competitor enjoys roughly the same level of technological skill, how does a company distinguish itself?

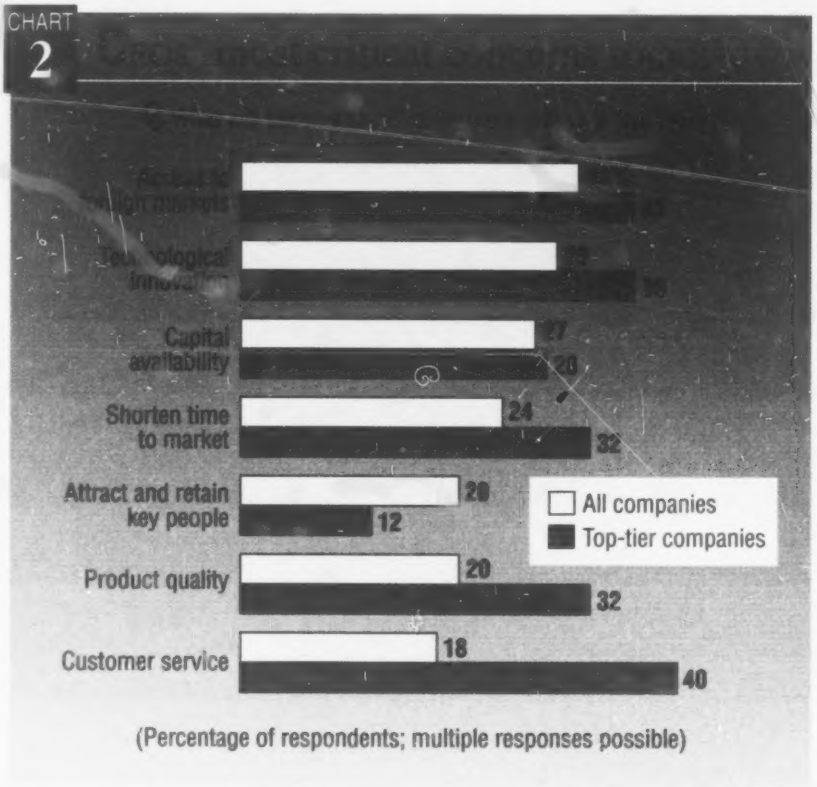
That question takes on special significance today, given the general perception that competitive pressures—mainly from Japan—are expected to intensify. While half of all CEOs surveyed believe their current level of technological innovation is very strong compared with their foreign competitors, the same number believes the country's technological edge is declining.

"The Japanese are very, very tough competitors," says Kent Black, COO of Rockwell International Corp. "They are very proficient in manufacturing skills and outstanding in technology, particularly when it comes to making something manufacturable at low cost. That is one of the most critical issues we face in telecommunications today."

In general, it is large companies such as Rockwell that are the most worried about technology. When asked to rate their competitive position in technology relative to foreign competitors, nearly half of these top-tier companies (those with annual sales over $300 million) think they currently have a very strong position. But forecasting their position out to 1995, the figure drops dramatically.

Why are these seemingly secure companies so pessimistic? One reason is that they already have the broadest exposure to foreign competition. They see first-hand the inroads that the Japanese are making in their markets and do not see the trend being checked any time soon. Another is that they often find it most difficult to adapt to changing environments—lumbering bureaucracies and responsibilities to an installed base make change a slow process. "The hot new products rarely come from the giants," asserts T. J. Rodgers, CEO of fast-track Cypress Semiconductor Corp., a $225 million maker of static RAMs in San Jose.

CHART 2



(Percentage of respondents; multiple responses possible)

That is a clear advantage for some nimble competitors. "Fortunately for us, bureaucracies within larger companies seem to have a natural tendency to kill motivation and innovation," says Robert Paluck, CEO and president of Convex Computer Corp. "We work very hard to do the things that DEC, IBM, and Cray can't or won't do to keep the employees happy and motivated."

Despite such bravado, concern over technology development is widespread, particularly when it comes to efficiency of product design and development. Defining customer needs and ensuring product quality are the two most important product-development issues for CEOs, especially at the front end of the development cycle.

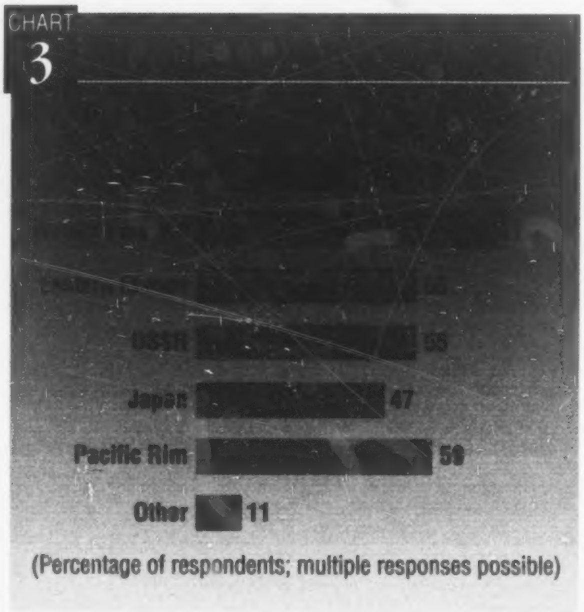
Chief executives admit that they are slow to identify and define market needs. Companies surveyed say they spend a disproportionate amount of time redesigning products and often end up adding last-minute design changes. In a fast-moving marketplace, a slow design process can mean death in the marketplace.

To address this problem, there is a growing trend among leading-edge companies to coordinate product design and development with input from the customer in order to lock in the product definition quickly. For some, this means getting the design engineers into the field to talk to the customers; for others, it means bringing customers into the lab to share their visions.

In some cases, it even means changing the organizational structure. "We have recently put all our R&D effort under the leadership of marketing and sales," says Nicholas Nadolsky, CEO of Micropac Industries Inc. in Garland, Tex. "That is a frightening idea to most of us, but if we are not willing to do that, then we are not very market-driven."

Another major part of the product development issue is time to market and the speed with which design is

CHART 3



(Percentage of respondents; multiple responses possible)

transferred to manufacturing. Shortening time to market is expected to become a much more critical issue among one-quarter of the survey respondents and is particularly critical for larger companies.

While concurrent engineering is receiving a lot of press, the survey demonstrates that the really big improvements still need to be made. Poor design for manufacturability is a significant cause for delay among 26% of the CEOs surveyed.

Another concern on the technology front is the deterioration of the basic educational system and the resulting drop in the quality of entry-level employees. Almost all CEOs interviewed are worried about the state of the educational system. They point to the added cost of basic training—including reading and writing—and the need for increased spending on retraining as some key concerns.

Educational deficiencies also appear in unlikely places. "English does not seem to be the first language of many of the engineering people. They have a hard time writing something that is understandable," says Richard Schaffzin, CEO of IC Sensors in Santa Clara, Calif. He encountered the problem when the company was writing documentation for the operation of equipment on the factory floor. "They are American-born and American-trained, yet their ability to write an understandable English sentence is not very good."

Even after the documentation has been satisfactorily edited, there is a problem with the reader not being able to understand the written word. To address the problem, IC Sensors has instituted a written test for all factory-floor job applicants. "If they can read English, it is a very easy test," says Schaffzin. "But we find that at least 50% of the applicants cannot even fathom what we are talking about."

Cozying up to the customer

Especially important today is the need to improve customer satisfaction. According to the survey, quality—as it relates to people, product, and organization—ranked immediately behind technology innovation as the critical issues for improving customer satisfaction and, therefore, maintaining competitiveness.

Pleasing the customer is one big reason for the astounding success of Conner Peripherals Inc., one of the fastest-growing companies in U.S. history. According to CEO Finis Conner, the secret of success for the disk-drive maker "has been our good relationship with the customer and our ability to configure products quickly and drive them in parallel with our customers to market faster than anyone else."

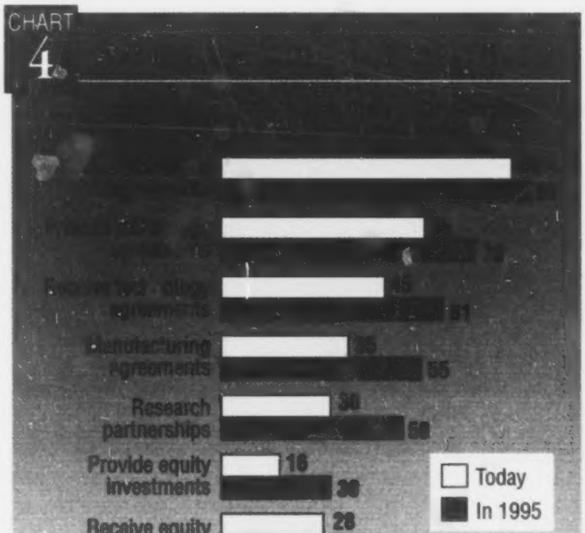
Quality and customer responsiveness are hardly new issues. But the ways in which electronics companies are moving to forge new corporate cultures based on a customer-driven culture *are* new. By definition, the customer-focused quality revolution touches all aspects of the corporation: cultivating employee motivation and empowerment, measuring performance of capital equipment and employees, improving supplier relations, and increasing the efficiency of R&D.

A bellwether of the focus on quality is the media hype over the four-year-old Malcolm Baldrige National Quality Award, which has become something of a benchmark of corporate quality in the United States. In fact, almost 50% of the companies surveyed agree that winning the Baldrige Award would improve their competitiveness.

So far, though, not many electronics companies are prepared to put their money (or their time) where their mouths are: Only 12% of the companies surveyed have either already applied or are planning to apply for the award.

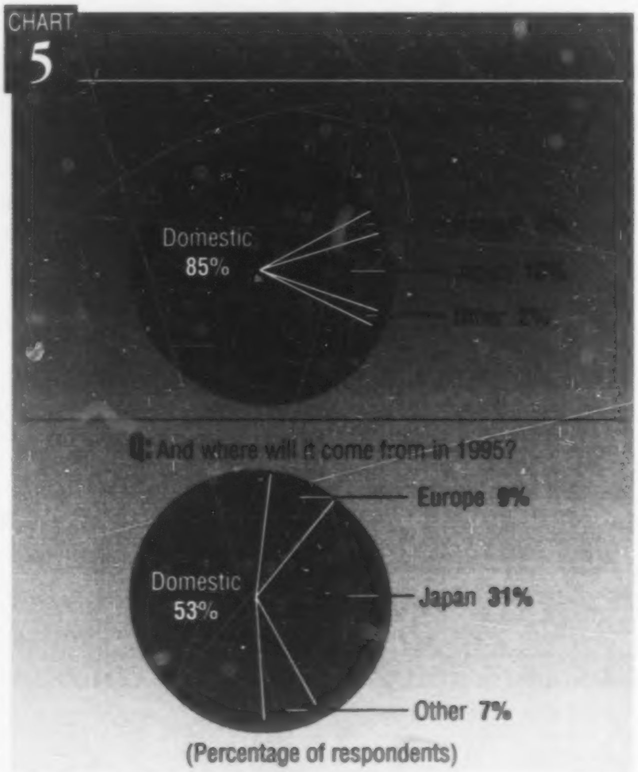
The few that have taken the time to evaluate the Baldrige criteria and apply them to their operations claim

CHART 4



(Percentage of respondents; multiple responses possible)

CHART 5



that the exercise is a revelation and a powerful motivator for change. "It permeates your entire corporation from a quality standpoint," says Jeffrey Goodman, former CEO of Bytex Corp. in Southborough, Mass. "Everything improves by default. It has to improve if you're serious."

Admittedly, U.S. electronics executives have a long way to go before achieving a state of defect-free quality. Indeed, opinion differs as to whether this is even the goal. But everyone agrees that customer satisfaction has now joined technological innovation as a determinant of corporate survival.

Naively, perhaps, most CEOs surveyed are optimistic that their efforts to improve quality and organizational excellence will pay off. While the issue will continue to dominate the 1990s, only a few surveyed believe that customer service will become "significantly more critical" to their competitiveness in the near future. Still, no single answer for improving competitiveness stood out with a majority vote from the CEOs.

The exception was among the largest companies surveyed. Forty-five percent of the CEOs from the top-tier companies think customer service will become more critical over the next five years, while 32% believe product quality will become more critical. Many of these large companies are in the computer and peripherals or semiconductor and components segments.

This concern by top-tier companies should raise a warning flag for the industry that their quality efforts, to date, are not adequate in the face of intensifying international competition. While the largest companies presumably have the most extensive foreign presence, they also face the fiercest competition from foreign companies here at home. It can be argued that the need for continued attention to quality should be shared by their smaller brethren.

Currently, the vast majority of CEOs claim their primary competition comes from domestic companies. But by 1995, they expect that situation to have shifted dramatically: On average, 31% expect the Japanese to be their primary marketing adversaries in 1995. For companies with sales over $300 million the figure rises to 44%.

Three concerns

Besides quality, three issues that CEOs identified as becoming more critical to their operations over the next few years are already common themes today: the ability to access foreign markets, continued technological innovation, and the availability of capital.

There is little mystery about why CEOs attach so much importance to these issues:

- Most CEOs surveyed agree that foreign markets hold the only prospect for healthy growth in the near term. For virtually every company, geographic market expansion is a cornerstone for strategic thinking among several CEOs;
- Staying ahead of the competition on the technology curve is particularly important to those companies in both rapidly changing markets, such as voice and data communications, and also for large companies weighed down by older technology;
- Access to capital is worrisome to companies with huge capital needs, such as semiconductor companies, or small, struggling companies in need of money for growth.

But while much has been said about all three of these topics, companies have been slow to act. For example, few companies surveyed currently sell overseas. Of the total combined sales of these 582 companies, three-quarters are in the United States.

This lack of foreign presence is disturbing. Still, most of the companies that currently don't sell overseas plan to enter Western Europe; over half are gearing up to sell into the Pacific Rim and Eastern Europe. A full 47% of the companies surveyed that don't sell into Japan today plan to enter that market.

With global strategies still in early stages and with a recession in full swing, expansion plans are increasingly being scuttled. The tardiness of foreign expansion could be devastating to many companies.

How do these companies expect to penetrate foreign markets? Most look to exports as the primary source of foreign sales. Likewise, entry through acquisition is considered by only one-twelfth of those companies surveyed, and only the largest companies have the resources to build or expand operations overseas. Regardless, the survey says U.S.-owned electronics companies will be spending 32% of their capital budgets abroad by 1995, up from the 20% they now spend.

Hoping to bolster their alliances in manufacturing, marketing, and technology, not surprisingly, most of the U.S. companies anticipate their partnering activities will be in foreign

INTRODUCTION

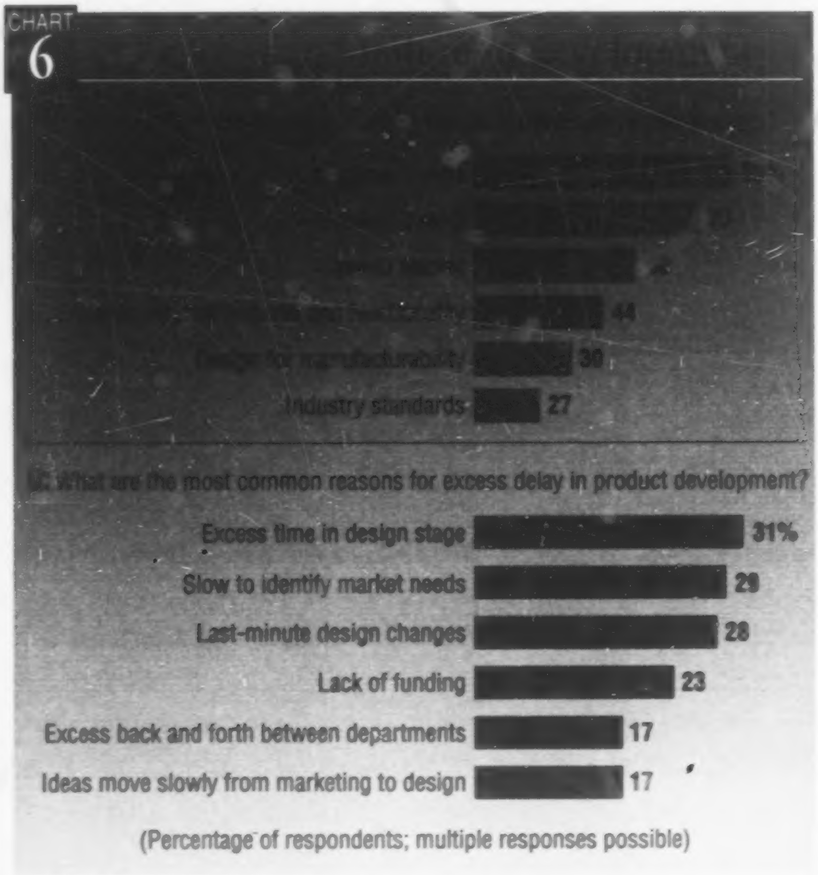


CHART 6

(Percentage of respondents; multiple responses possible)

markets. Domestic alliances now account for 69% of the total, but by 1995 that will be trimmed to 58%, say CEOs. Nearly 20% of the alliances will be in Europe, up from 11% today.

Computer and peripherals companies expect to be among the most active in Europe, more than doubling their partnering efforts there by 1995. Semiconductor and components companies expect to ink the most deals in Japan.

Last but not least on the list of top issues is capital availability. In general, the concern over capital is inversely proportional to the size of the company. Developing companies face the biggest capital challenge: More than half of these companies' CEOs rank capital as the most critical issue today. But looking out five years, the picture shifts. Top-tier companies identify capital availability as a serious concern almost as often as developing companies do. The reason is that world-class production facilities, especially semiconductor fabrication plants, require huge sums of money.

It is uncertain whether enough capital will be available at the right price and from the most agreeable source. Right now the IPO market is tight and the cost of venture funds is high. What's more, the LBO frenzy of the 1980s is over; only the deals that make sound financial sense will be attracting backers.

Because of the poor outlook in the capital markets, nearly one-third of the CEOs surveyed expect to sell their companies by 1995. Most of the activity will be among the developing and small companies, although 6% of the larger companies expect to be acquired. While the majority of the respondents expect domestic acquisitors, 21% forecast their new parent will be Japanese, and 18% see a European takeover in their future.

For companies not contemplating a takeover, the only other source of help is the government. The majority of the CEOs surveyed look to the government to provide some relief by creating a permanent R&D tax credit and a capital gains tax indexed to zero for long-term investments. These demands are not new. The American Electronics Association, for one, has been harping about these issues for several years on Capitol Hill, with little progress to show for the effort.

Part of the blame goes to President Bush, say CEOs. Because of the administration's inability to convince Congress of the need to cut taxes and reduce the federal budget, the industry gives Bush a flat "C" for his management of technology issues.

Two-thirds of the CEOs surveyed would like an electronics industrial policy that includes a recognition of the strategic importance of the industry in trade negotiations as well as the tax breaks. Says Robert Anderson, CEO of GenRad Inc., "Until our government understands that we are playing by different rules than the Japanese and the Germans, we are going to increasingly lose market share in most of our technology markets."

While Anderson's views are echoed widely, there is a consensus among industry leaders that *direct* government meddling is unnecessary and undesirable. For instance, over three-quarters of the respondents reject the need for a government-backed technology-oriented venture capital fund, higher spending on basic research by the government, or the creation of a MITI-like trade institute.

Robert Galvin, former chairman of Motorola Corp., has put forward the idea that the government's role should be to place its imprimatur on certain desirable objectives but let industry take responsibility for implementation. Galvin points to the Malcolm Baldrige Award as a prime example: In this case, the government has given its blessing, but the award is privately funded and privately administered.

Many CEOs insist that the government must take a more proactive role in the industry's well-being for it to survive the 1990s. How they position themselves and what actions they take are the focus of the remainder of this study. ☐

A blueprint for COMPETITION

BY BRUCE C.P. RAYNER

KEY FINDINGS:

- ☐ *U.S. companies are ill-prepared for increased foreign competition*
- ☐ *Innovation and quality define the competitive company of the '90s*
- ☐ *CEOs worry most about innovation, capital availability, and foreign markets*
- ☐ *Top goals include fine-tuning core competencies and teaming up with suppliers and customers*

For today's electronics company, competition comes in many shapes and sizes: from large players and small, from vertically integrated and niche companies. And unlike years past, your toughest competitors are just as likely to be based halfway around the world as on the next block.

Are CEOs worried? You bet they are. They see foreign competitors eating away at their markets and beating them in terms of customer satisfaction and quality. In response, most CEOs have focused on efforts to trim costs and improve product quality.

But these efforts are only the beginning of a major rethinking of the U.S. corporation and a redefining of the rules of competition. Hal McInnes, chairman and CEO of AMP Inc., sums up the situation this way: "To be a viable competitor in the future, quality must be a given. You absolutely *must* be world-class in quality or you won't survive." The survivors, in other words, will be the companies that consistently meet or exceed customer expectations by offering sophisticated, competitively priced products that are 100% defect-free.

Alas, there are not many such companies out there, according to the 1991 ELECTRONIC BUSINESS/Ernst & Young CEO survey. In fact, the average U.S. electronics company paints a pretty bleak self-portrait. While most companies recognize that technological innovation, product quality, and customer service are crucial to competitiveness, many claim to be playing a perpetual game of catch-up with their foreign rivals.

For instance, 65% of all CEOs in the voice and data communications segment rate technological innovation as most critical to competitiveness, and 44% think that innovation will become even more important within the next five years.

But these same executives see a marked deterioration in their technological edge during that period. The story is repeated in other industry segments and in other competitive criteria. Only 9% of all computer and peripherals companies now see Japanese companies as their stiffest competitors. But 49% expect Japan to be the number-one computer competitor in 1995.

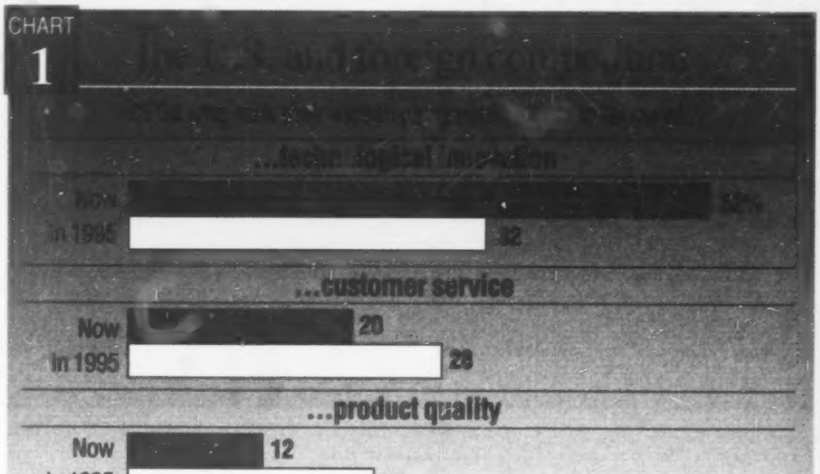
Fighting back

Many companies are focusing their efforts on core competencies, shedding peripheral functions that add no value to their operations. For GenRad Inc., a maker of test equipment, that means focusing on test-equipment solutions. "We can add value by finding the best way to solve some specific test and measurement problems," says CEO Robert Anderson, "not by re-inventing user interfaces or computer architectures."

Concentrating on core competencies also means a closer relationship between suppliers and customers. As companies sharpen their focus, the reliance on cooperative R&D and product development increases proportionately.

The survey reflects this trend. Across the industry, alliances of all types are on the rise. Manufacturing agreements are expected to explode in the next five years: While 35% of our CEOs claim to have some sort of manufacturing alliance today, the figure will rise to 55% by 1995. Like-

CHART 1



(Percentage of respondents; multiple responses possible)

wise in research partnerships, which will rise from 30% today to 50% in 1995.

As offshore competition intensifies, so does the need for producers in the United States to join forces with foreign companies. These foreign alliances throughout industry will become more significant over the next five years, especially between U.S. and European companies rather than between U.S. and Japanese companies.

For instance, semiconductor companies currently have only 9% of all their alliances with European partners and 29% with Japanese partners. But by 1995, those figures are expected to be 18% and 26%, respectively. Similar figures are projected in the computer and peripherals sector.

The trend for more alliances is motivated by the need for quicker product development and better communication between the supplier and the customer. "The whole key to competitiveness is really the relationship with the customer such that the customer is willing to tell us exactly where they are headed," according to Michael Cope, CEO of Interphase Corp. Cope claims that because of Interphase's status as a long-term developmental partner, customers provide information they would be unwilling to share with most suppliers.

Robert G. Todd, Jr.,
Chairman and CEO,
Flextronics Inc.

On reliability. . .

"Interestingly enough, reliability is the one area where there ought to be a lot more going on than there is between us and our customer. Reliability is a part of quality, but we've found that it doesn't get the same focus.

"We have only one customer who supplies us with reliability data on his products through his service department. Usually there are good reasons why they can't provide the data, but nevertheless, we usually don't get it. Therefore it's hard for us to do anything about improving our reliability or get back to our suppliers so they can improve *their* reliability.

"What we can't get from our customers is data on how our products have performed in the field. If we produced 30,000 of these things last year, we want to know what's failed and why. You just can't get that kind of information." ☐

In many of the companies, the focus is on concurrent engineering that involves cross-functional teams representing marketing, design, and manufacturing. But companies are increasingly realizing that unless these teams can lock in a design early on, they lose much of the value of the team effort. To address this issue, many companies involve the customer in the product-development cycle through written surveys and market studies.

But according to some CEOs, these techniques are grossly inadequate in gauging customers' expectations. What is needed is more one-to-one contact between engineering, management, and the customer. In one case, a CEO sent his engineering team to Comdex in Las Vegas to serve booth duty. The idea, says David Feldman, chief executive of Ampro Computers Inc., was for the engineers to meet customers face to face to get a feel for what the customer wants. "They came back with a totally different perspective of what's needed," he says.

The same closeness applies to salesmen. Stan Karandanis, CEO of Datacube Inc., says that, in theory, salesmen should listen, not talk. "Unfortunately, most of my salesmen talk," he concedes. "What you want to find out is what the customer needs. It's a communication issue. You have to work on improving [the salesman's] ability to listen through classes and through training."

This ability to listen to the customer is the key to Conner Peripherals' success, says CEO Finis Conner. Instead of relying on the traditional design-build-sell strategy of most technology companies, Conner employs a sell-design-build strategy. That is, customers tell the disk-drive maker exactly what they want, then

Jim P. Manzi,
President and CEO,
Lotus Development Corp.

On Japanese competition in software. . .

"It's loony tunes to think that [the Japanese] can conquer automotive engineering—and every other form of engineering—but won't figure out how to conquer software engineering. There is a big infrastructure built in; software is a priority for MITI. They are bringing in Chinese software engineers. NEC is doing it, Fujitsu is doing it. . ."

On software quality. . .

"If you took a poll asking what people thought the most important thing in the company was, they would say 'quality.' It transcends everything that goes on here. We spent $15 million testing 3.0 Lotus 1-2-3, which was twice the cost of development.

"The quality burden is so great on us because of the immense obligation we have to the installed base for quality, maintainability, and compatibility. So this has been a major fixation here since the beginning. There is a big requirement to do it more efficiently, and we are investing in ways to do that.

"For example, our biggest customer for Notes says the mean time between failure is not a relevant concept. What is relevant is mean time between repair. It doesn't matter if it breaks four times a day as long as it is fixed in 10 seconds. So before you write the applications software and networking software, you need a good understanding of the customer's quality requirements." ☐

Dr. Richard Schaffzin,
Chairman and CEO, IC Sensors

On measuring performance...

"Beyond communication and quality, the key piece of the puzzle is measurement. I think that people work better if they have a measurable goal. We've gotten it down to the point where every employee in the company has one or more measurable goals. And we're finding that people can do a much better job if you *expect* them to do a much better job. It's the old adage that work expands to fill the time available. People used to put out 200 units [illegible] shift because that is what they were expected to do. If we go back to those same people and say we want them to put out 1,000 units, miracle of miracles, they do it.

"So getting the measurements at every level of the organization, then patting them on the back when they do a good job and kicking them in the pants when they do a bad job, seems to work." □

Conner designs it to those specifications, produces it in volume, and ships it before the competition can get a look. "Our customers tell us they want a drive that has this form factor, this capacity, this performance, this cost, this reliability," says Conner. "So we know up front everything we need to know when designing a product."

Besides getting closer to the customer, some companies realize that it is how they measure themselves that is getting in the way of serving the customer. The solution is to redefine the metrics that measure their performance so that they become more customer-focused.

IBM has put in place a program called Market-Driven Quality that attempts to measure all operations on a customer basis rather than an internal basis. For instance, Big Blue has changed its software metric from bugs per million lines of code to problem days per customer month, permitting IBM to better gauge the customer's overall satisfaction with the product.

A company's competitiveness is measured by how global a player it is. Not only must it be able to source product from around the world, it must have an infrastructure which enables it to sell into all the major world markets.

But in most cases, U.S. global competitiveness is lacking. According to the survey, U.S. electronics companies sell an average of 75% of all their products in the United States, 11% in Europe, and 5% in Japan. Most plan to increase their foreign sales within the next few years, but by then it may be too late. Already, growth in the U.S. market has slowed. Big companies are pegging their growth prospects now on their foreign sales. Moreover, most plan to boost foreign sales through exports, a strategy that many experts see as inadequate. Consultants at PRTM, for example, insist that only companies that have a visible local presence in foreign markets will succeed.

That is just what AMP Corp. is planning, says CEO McInnes. He expects to maintain a 15% annual growth path for the connector giant by slugging it out in geographic markets. "We have excellent opportunities in the Asian market, mainly Taiwan and Singapore," he says. Like other companies, AMP is counting on Asia to post the biggest growth, followed by Europe and the United States.

But while that might work for a seasoned multinational, it is the exception to the rule, according to survey results. The picture of U.S. global manufacturing presence is even worse. Over 93% of all companies' 1990 capital budgets are for domestic facilities, and 81% of 1995's budgets will be pegged to domestic spending. This implies that the global infrastructure is not in place, nor will be any time soon. Without it, companies are held captive by domestic economic conditions.

Of course, there are exceptions. The Cherry Corp., maker of switches for the automotive industry, has pursued a global manufacturing strategy for years. "Flexibility is the byword here," says CEO Peter Cherry.

International sourcing is extremely important to Cherry, particularly in an era of fluctuating currencies. "You need to be able to change your sourcing decisions quickly," he says. The company practices what it preaches: It makes PC boards in India, stuffs them in Czechoslovakia, and assembles them in Germany.

Because so many high-technology companies lack a global presence, the question of government protection is a natural one. But, CEOs feel that the government should recognize that the U.S. electronics industry is

T. J. Rodgers,
President, CEO, and director, Cypress Semiconductor Corp.

On government restrictions...

"I have problems understanding the thinking in the Commerce Department. If you get Soviet scientists to come over here and let them access our technology—the guy that invented the ELBRUS 1 supercomputer might have to do a data capture on a Sun workstation—you'd be accused of exporting technology to him.

"We find some strange things as we get further into the laws of [the Single Market]. The premise is they'll force you to have a fab over there. From what I hear, the duty is 14% if you make it outside [Europe] and ship it in, but 9% if you make it outside but test it inside.

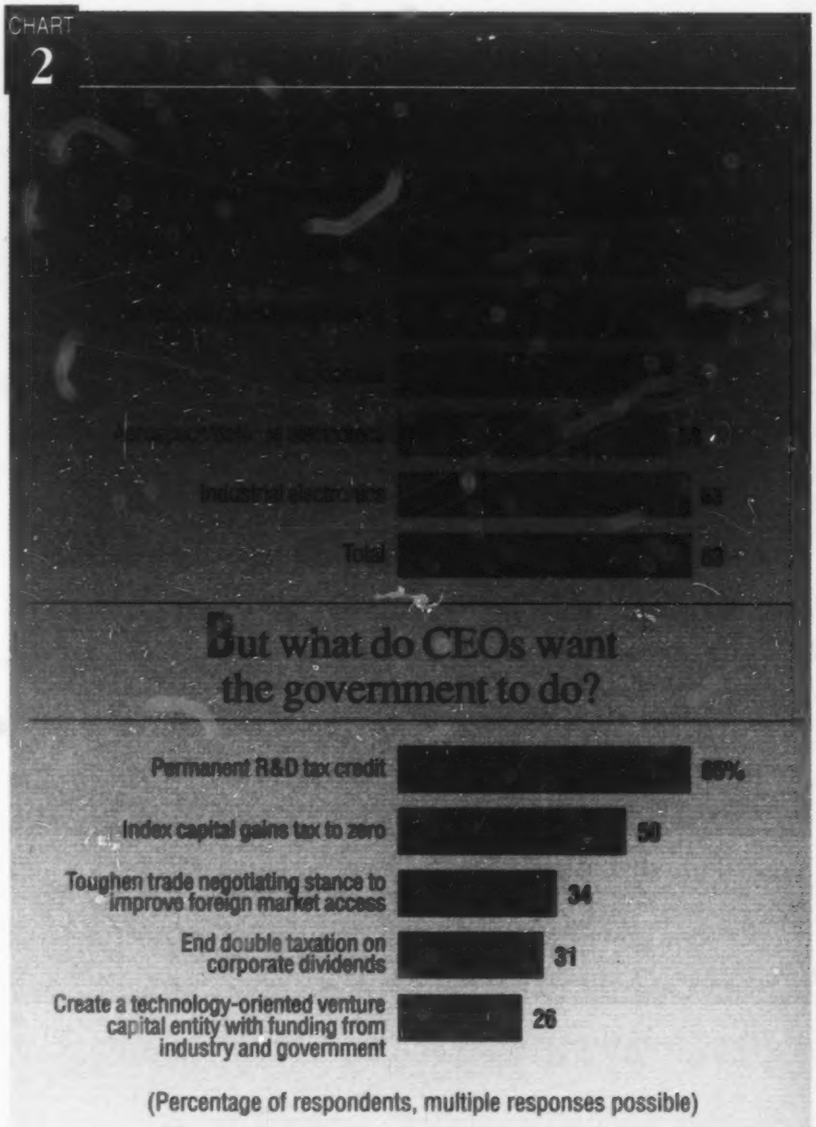
"Our first thought was to go for the fab and avoid the duty. Then we learned that if we make wafers over there and assemble and test them here, the duty jumps back up to 14%—with no credit for the fab at all. Their incentives go in the wrong direction for people to build fabs over there. The coercive utopians who are putting together the plans don't understand what kind of incentives they're creating..." □

Peter B. Cherry,
President
and CEO,
The Cherry Corp.

On partnerships. . .

"I can point to several instances where I would say yes, there is something that transcends the traditional good customer relations in this era of partnerships. Partnerships is almost too strong a word, but you certainly get a preferred supplier status. You have some people who say it and mean it, and you have some who pay it lip service." ☐

CHART
2



(Percentage of respondents, multiple responses possible)

strategically important to the country. In all, 63% of CEOs surveyed agree that the U.S. needs a defined electronics industrial policy.

However, that means electronics industry CEOs want the government's recognition that their industry is strategically important to the economic well-being of the nation. It does not mean the CEOs want the government to take an active role in the industry's management. Most CEOs are vehemently free-market supporters with the stipulation that the government should make it easy for them to raise capital and conduct R&D.

"I'm a very strong free-enterpriser. I think the federal government ought to stay the hell out of the way in almost all cases," says Kent Black, COO of Rockwell International. But he does allow for a few exceptions, one being R&D. "Right now we have a system that says you are going to be covering in your overhead rates to about 85% of what you are willing to spend in R&D, which is a demotivator in part." As chairman of the Aerospace Industries Association committee on R&D, Black proposes treating the R&D expense like any other expense, such as utility bills, instead of putting it in a separate category.

Some CEOs are more alarmist. "The longer it takes for the government to establish policy on technology, the more we will continue to lose our edge," says one CEO.

Reflecting this sentiment, a full 26% of the CEOs surveyed would like to see a technology-oriented venture capital entity created with funding from both government and industry. And 18% agree that the U.S. should set up a MITI-like institute—Japan's Ministry of International Trade and Industry—to coordinate trade. It is doubtful, however, given the Bush administration's position on government involvement in industry matters, that such a move will be made.

While the value of consortia was not addressed in the survey, the CEOs who participated in the roundtable discussions and interviews are still debating the issue. Some CEOs interviewed are concerned that the cooperative R&D efforts have been slow to produce results. Whatever else the industry can do, with or without government aid, remains to be seen.

Ultimately, the competitiveness of a company is based on its management and its products. While management can focus resources on maximizing profits or growing sales, the future rests in the hands of the customers. Quality and integrity of the product is key, and that is where U.S. companies still need a lot of help. ☐

The rising price of TECHNOLOGICAL LEADERSHIP

BY BRUCE C.P. RAYNER

KEY FINDINGS:

- ☐ *U.S. technology is strong now but will decline in the next five years*
- ☐ *While the U.S. depends on technological breakthroughs, basic research spending is falling*
- ☐ *Closer customer contact is needed to define market needs and shorten product development time*
- ☐ *Networking will make new demands on U.S. technological expertise*

Technological innovation is the most critical issue for maintaining a competitive advantage, according to results of the 1991 ELECTRONIC BUSINESS/Ernst & Young CEO survey.

But all is not well on the national technology front. For one thing, half of the CEOs surveyed believe the U.S. technological edge is now declining, while 41% expect it to decline further during the next five years. Most of the concern is registered among CEOs who run computer, peripherals, semiconductors, and components companies. Yet compared with last year's survey, the CEOs are less pessimistic about the U.S. technological edge.

There is another warning flag. Over half of our CEOs believe technological innovation is currently a strength. But when asked to predict U.S. prowess five years from now, their confidence drops precipitously: Just one-third of the respondents believe their technology will be considered "leading-edge" by 1995.

Not surprisingly, Japan is seen as the biggest threat. But companies seem to be doing little to fight back. R&D spending as a percentage of sales, for example, is expected to decline over the next five years, and less will be pegged to basic research.

It is no secret that in times of belt-tightening you make what you have go further—using R&D funds more effectively and developing products more efficiently. One answer, say CEOs, is to team with other companies so that R&D efforts remain focused.

There are other tricks. CEOs talk about focus and the need for purging the "not-invented-here" bias from their engineering departments; reinventing the wheel is too costly. CEOs look to cross-functional development teams and improved customer involvement as panaceas for solving their technology woes.

While these tactics are pursued vigorously, the survey identifies a few gaping holes in the electronics companies' ability to retain their technological edge. For one, CEOs admit they have a big problem with product development, primarily in capturing good market data and freezing the product design early in the design cycle. Bad market information results in last-minute design changes, a slowdown in cycle time, and lost business because the company was late to market. In all, 30% of the CEOs call their inability to identify and define market needs a "significant factor" in slow product development.

"Customer involvement," today's most popular buzzphrase, speaks to the issue of speeding the pace of product development. By bringing customers into the company to contribute their thoughts on what they want, product definition can be fixed early, and product development can go more smoothly. The more work done up front to define the product, the less work overall.

"I think the Japanese spend more time on the front end [than we do]," comments Gary Tooker, COO of Motorola Inc. "They get their plan together and stick with it so the total

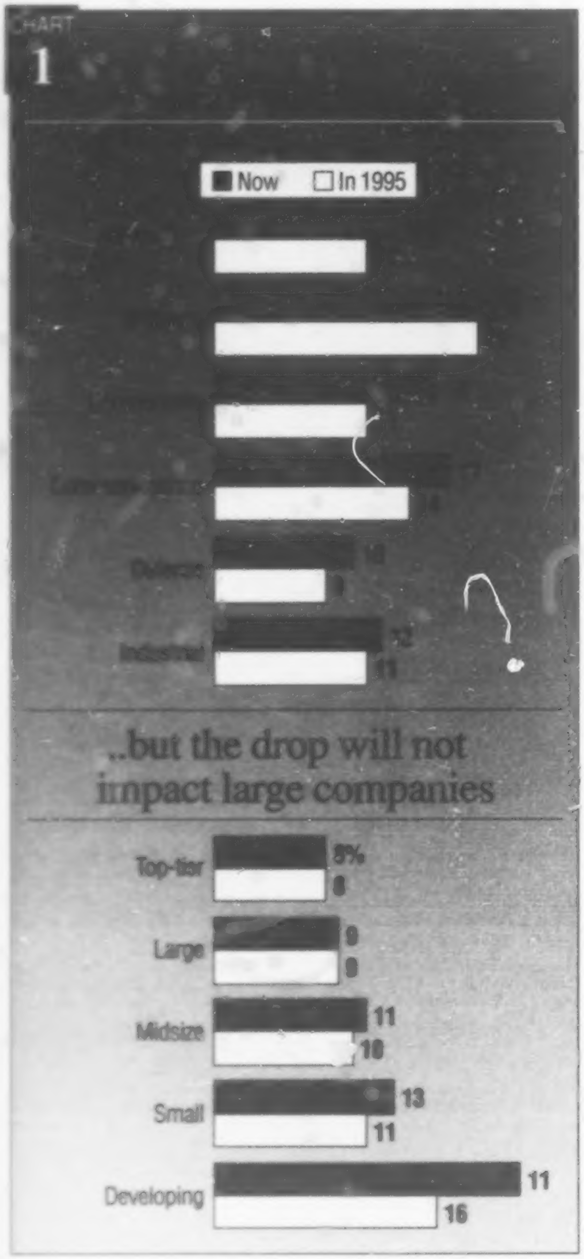
James L. Donald,
Chairman, president, and CEO,
DSC Communications Corp.

On rapid product development...

"If you come in with a project that looks right and proves itself out, we'll approve it in 30 minutes. It doesn't take mounds of presentation material or months of time before we decide...

"Our first cross-connect product came about when two engineers came to my office and said, 'We have an idea for a new product that fits in with what [the company] has been talking about.' I told them to get some data together. These two fellows made a presentation to our development head, our marketing guy, and me. In maybe 30 minutes to an hour we were persuaded, and we started the project two days later. It was the right project, it was very, very clear, and we brought the product to market before anybody else." ☐

CHART 1



elapsed time can be less—even though it looks like they spent too much time up front."

But except for the Japanese and the occasional U.S. company, is customer involvement a reality? Not for the larger companies, according to the survey: Last-minute design changes are a significant problem for over 40% of companies with sales over $300 million. The figure declines to just 17% for companies with sales under $1 million.

The problems of design capture are exacerbated by the fact that design for manufacturability is still considered a pipe dream by many CEOs. Despite talk of cooperation between design and manufacturing, 18% see lack of communication as a major obstacle to cutting cycle time.

Again, the problem is most acute among larger companies. While it is a concern to only 21% of the developing companies surveyed, design for manufacturability is a problem for 46% of companies with sales over $300 million.

Besides design for manufacturability, executives are most worried about supplier delays. While they tout their supplier "partnership" programs, poor delivery response times by suppliers are still a problem for many companies. This is complicated by the fact that some companies rely on foreign sources for many components. When these are in short supply, relationships break down.

While U.S. electronics CEOs are pessimistic about their technological competitiveness, there is less uncertainty concerning breakthrough technologies. Over three-quarters of all respondents believe that U.S. competitiveness is dependent on technological breakthroughs, and nearly 90% expect major breakthroughs in the next few years.

Historically, the Japanese electronics industry has not relied on breakthrough technology for its success. Instead, Japan focused on incremental improvements in both product and process; the nation has only recently increased its national focus on R&D. Now the threat from Japan comes from their ability to improve process technology and their investment in basic research for a myriad of advanced technologies.

If the U.S. electronics industry is right in believing it can continue

Robert J. Paluck,
Chairman, president, and CEO,
Convex Computer Corp.

On simultaneous engineering...

"We organize around a purpose, and the purpose is to get a system out before the competition can. An important part of this is simultaneous engineering. That is, manufacturing truly working with development and purchasing on the product. The third generation of product that we'll be coming out with next year is completely simultaneous engineering. The manufacturing, development, purchasing, and materials people have all worked together simultaneously for the last two and a half years. Marketing got involved a lot later, probably the last year, from a promotional standpoint. Marketing was also involved much earlier in the definition of the product.

"We have our development engineers working with the customers, finding out what they really want. There has to be an interpretation between what the customers say they want and what technology can actually provide. We also have to guess what the customers are going to want two years down the line. So it takes many sophistication from the engineer, but marketing is there [to help] too." ☐

churning out technological breakthroughs, then there is no cause for concern. But there are signs that the pace cannot be maintained. The reason: Breakthroughs depend on basic research and 61% of the CEOs surveyed agree that U.S. basic research is declining.

There can be pitfalls in becoming too enamored with or dependent upon technological breakthroughs. The Cherry Corp. in Wa[illegible] Ill., for example, has invested heavily in electroluminescent flat-panel displays for the past five years. "I relied on it too much as the engine for the future," says CEO Peter Cherry. "It's not going to jump-start us now, so it's best to get on with other things, such as semiconductors."

In semiconductors, Cherry has identified the most popular of the new technologies. In all, 66% of all CEOs believe that advanced semiconductors hold the most promise for the nation and are considered crucial for the future of the country by 65%. Other key technologies are advanced materials, advanced telecommunications, and high-performance computing. This reliance on U.S. semiconductor strength is rather alarming, as results from last year's ELECTRONIC BUSINESS/Ernst & Young survey indicate that the U.S. position in microprocessors was expected to drop drastically over the next five years.

Improving the efficiency of R&D funds is a central issue for many CEOs. For the most part, better utilization of funds which are earmarked for product development means a tighter focus on R&D. There are many implications of this strategy: closer technology ties between companies up and down the silicon food chain, more niche strategies, and acceleration toward and growing preference for standards.

"For the first time in our industry, we'll see more and more standards coming into place in the '90s," argues Robert Anderson, CEO of GenRad

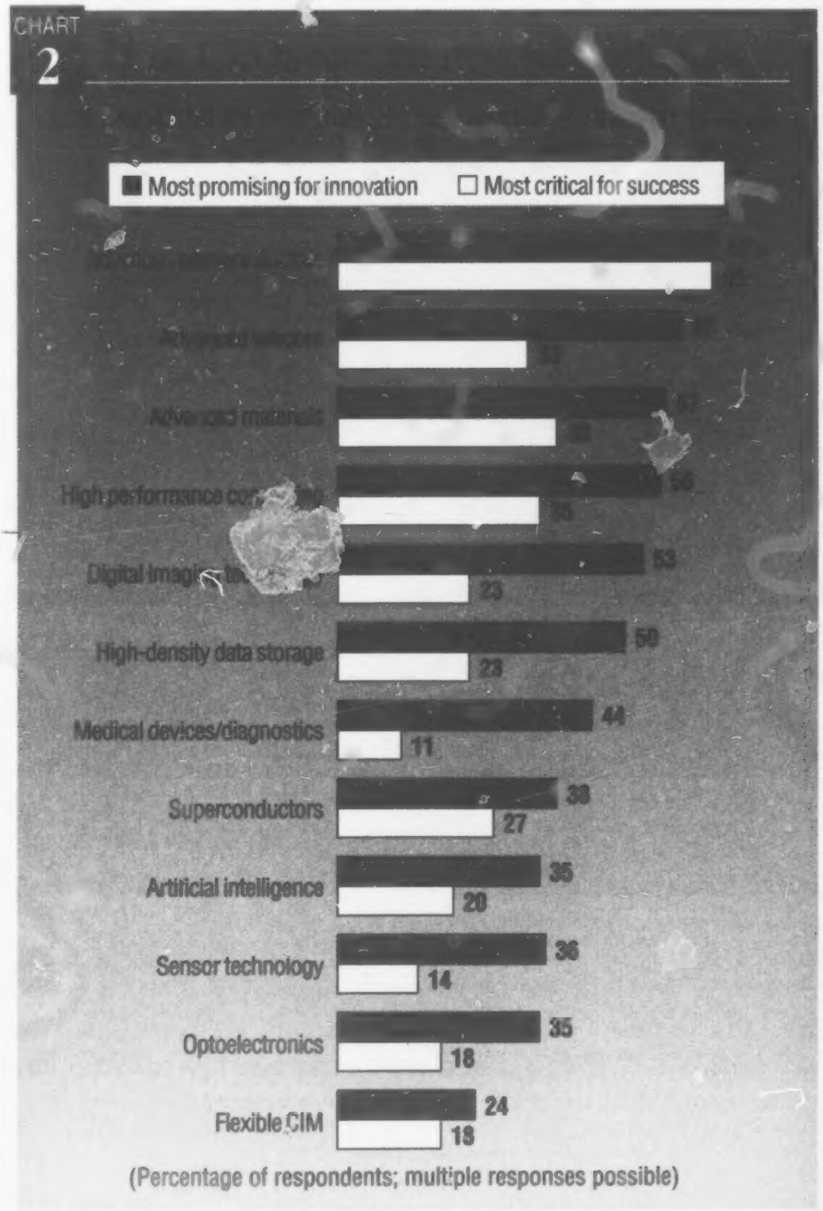
Robert E. Anderson,
President
and CEO,
GenRad Inc

On wandering designs...

"One of the key factors that drives time to market is how good a job you do in the product definition up front, because if you don't have a nice crisp definition of what you want, you can waste an awful lot of time with a wandering design until it is finally done.

"We will be doing a lot of work in the future with quality function deployment, trying to make sure we get it right before we go off and start spending all that precious R&D money. QFD is a very good way of making sure that we are really listening hard, getting the right message, and then making sure that everybody on the team genuinely understands the message." ☐

CHART
2



(Percentage of respondents; multiple responses possible)

Inc. in Concord, Mass. Standards, Anderson says, will give GenRad a more focused R&D effort and a richer array of products.

Standards are the wave in open systems too, notes NCR Corp.'s Elton White, executive vice president for marketing. "We think that the open systems trend revolves around standard interfaces that let systems work together," he says. "If you have islands of automation that exist in the enterprise today, then interfacing becomes important."

Networking is driving the open systems and standards trend. But networking raises new issues, especially for software companies. "We get about a million calls a year for technical support," says Jim Manzi, CEO of Lotus Development Corp. One of the challenges for companies like Lotus in the future will be providing technical support for networked customers. "The support requirements will increase by an order of magnitude," Manzi says.

David L. Feldman,
Chairman and CEO,
Ampro Computers Inc.

On offering fewer products...

"We are now on a fairly aggressive schedule of cutting our product offering. We are in the computer module business, but we were making things like enclosures and cables, trying to be all things to all people. By eliminating all those other things and focusing on the boards, we've become much more efficient and much more valuable to our customers as a board supplier.

"The efficiencies have allowed us to cut costs. In March, we had a 20% across-the-board price cut, and we had another one in January. This focusing has allowed us to have a schedule of introducing a new product a month. By focusing what we are doing, they are all very synergistic products.

"When we come up with the initial spec for a product, it's not just 'does it have all the bells and whistles and is it faster than someone else's?' In many cases we're introducing products that are slower or don't have some performance features, because we have tried to talk to the customer and find out what they want.

"I'm forcing more people to go to the customers, and that includes designers. I had our engineers do booth duty at Comdex last year. They talked to the customer and came away with a totally different perspective of what's needed out there and of the need to design products that will meet those needs. We are trying to make the whole company marketing-driven." □

Networking and other factors are also driving the need for technology alliances among electronics companies. The alliances between IBM, Digital Equipment Corp., and others for the Open Federation Unix project is a case in point.

According to the survey, over 50% of all companies have some sort of technology alliance; 56% are providing technology to another company, and 44% are receiving technology from another company. By 1995, nearly 70% of the companies surveyed expect to be providing technology licensing agreements.

Aerospace and defense electronics companies expect to post the biggest increase in the number of technology alliances in the next five years. Currently 52% of these companies provide technology to other companies and 42% are on the receiving end of technology licenses. By 1995, however, those figures will rise to 84% and 59%, respectively. The same picture, though to a lesser degree, is painted in the other major segments of the industry.

Most of the aerospace and defense electronics alliances are now with U.S.-based companies and will probably remain so. But in other segments, foreign alliances are expected to see considerable growth. For instance, in the computer and peripherals segment only 7% of all alliances are currently with European companies, and 17% are with Japanese companies. By 1995, those figures will rise to 20% each.

Along with foreign alliances comes the need for companies to set up their own R&D efforts overseas as markets or sources of talent shift. DSC Communications Corp. has its R&D in the U.K. but is now setting up a remote R&D center in Japan. "There are unique features that apply to that market," says James Donald, DSC's chief executive. While the office will be staffed by U.S. transplants initially, Donald expects to switch to Japanese nationals.

The reason for shifting R&D overseas? Local requirements, particularly in software. "It is kind of loony to think that someone sitting in Cambridge, Mass., would have a feel for [a foreign] market," says Lotus's Manzi. All Lotus products are "internationally enabled," meaning that the code allows for translation and supports an enriched international character set.

Japan was the first place Lotus set up its remote R&D, but the company is expanding in other regions. While Lotus did most of its translation work out of Dublin, it is now expanding across Europe and Asia. As the electronics industry becomes more software dependent, moreover, the need for globalization of development centers will increase. DSC's Donald notes that even the telecom business is becoming more software-intensive.

In other cases, the need for remote R&D centers is driven by demographic factors. "I see remote R&D as a growing trend," says T. J. Rodgers, CEO of Cypress Semiconductor Corp. in San Jose. "We need more and more engineers, and they simply aren't available in Silicon Valley at any price." Cypress has design centers in Startesville, Miss., and Austin.

While finding and retaining good technical people is an issue for all companies, most CEOs stressed that as long as a competitive salary was paid, the engineers would appear.

It is not clear whether that sentiment is just false hope. What is certain, however, is that more minorities and women joining the engineering ranks in the next century. How that will effect the structure of technology development in the U.S. electronics industry is too hard to predict. □

The changing face of the ORGANIZATION

BY ELIZABETH B.BAATZ

KEY FINDINGS:

- ☐ ***Commitment to quality and customer satisfaction are the keys to organizational excellence***
- ☐ ***CEOs lack reliable tools for gauging the effects of their companies' quality programs***
- ☐ ***The successful corporation demands motivated, well-trained workers and excellence at the very top***
- ☐ ***CEOs rank training and education as top priorities***

Given fierce global and domestic competition and the blistering pace of technological change, organization is more critical than ever for today's electronics company. What are today's CEOs doing to manage their organizations for survival and success?

Not surprisingly, the ELECTRONIC BUSINESS/Ernst & Young survey revealed no clear consensus on a single most critical strategy for companies to reach or sustain exceptional organizational performance. In other words, there is no magic answer. Most executives, however, offered two suggestions for helping to achieve organizational excellence: measuring customer satisfaction and committing the entire company to quality. Ironically, less than one-third of our CEOs agreed that either of these suggestions are very important to their strategies.

Not measuring up

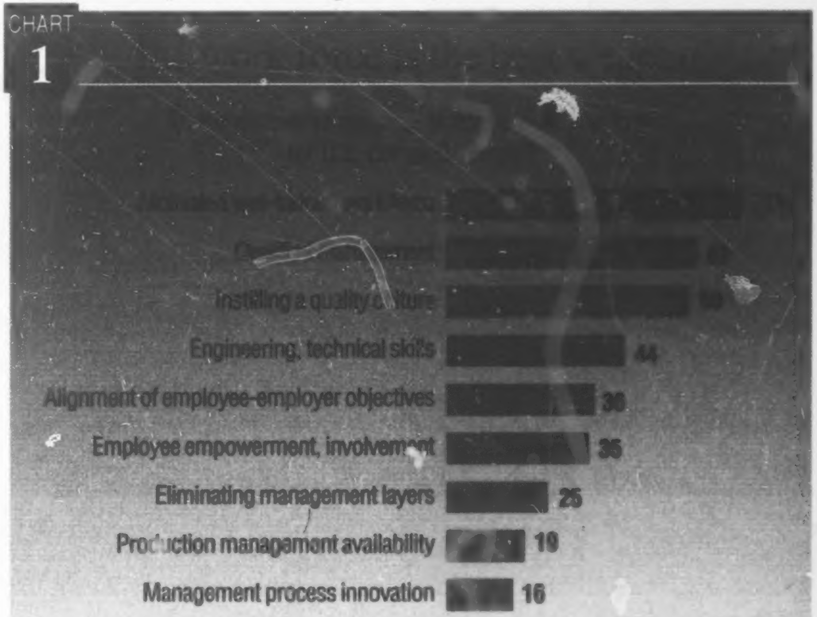
Measuring customer satisfaction may be strategically important, but a significant number of CEOs in the survey are less than satisfied with their company's measurement techniques.

Although only a handful of companies in the survey have applied or plan to apply for the Malcolm Baldrige National Quality Award, over three-quarters of the CEOs surveyed said their company has a quality improvement program underway. In fact, a full 90% of midsize companies and nearly 95% of all large and top-tier companies in the survey have some form of quality improvement plan in the works.

But two-thirds of the CEOs admit to inadequate techniques for measuring product quality throughout the development process. Even among the largest companies with the deepest pockets, 20% are dissatisfied with their measurement process. By industry segment, companies in the area of industrial electronics, communications, and software expressed the most dissatisfaction with their product quality yardsticks.

As for measuring customer satisfaction specifically, only 29% of the respondents said that providing a system for measurement would be the most important part of the plan to ensure customer satisfaction. Also, only 15% indicated that linking employee incentive plans to customer satisfaction measures would be most important; instead, nearly three-quarters of the respondents said their most important initiative in order to ensure customer satisfaction was "to commit management to build a customer-driven organization."

The most popular method CEOs use to measure customer satisfaction may be considered a bit old-fashioned. Over 66% of the CEOs ranked personal visits to product users as



(Percentage of respondents; multiple responses possible)

their most useful measurement technique. Another 49% said interaction with upper management in the customer's company was most useful.

The more scientific methods of measuring performance ranked lowest. Customer-service tracking systems, market research surveys, and field audits each were marked by less than one-third of the respondents as most useful. While electronics companies have become more market-driven, the industry's adoption of formal measures of customer satisfaction appears to be lagging.

Every CEO worships at the altar of customer satisfaction and product quality; pressure from foreign competitors has made this a must. But moving to actual implementation of measurement and controls still needs to happen by electronics companies.

Instead of measuring, executives are busy motivating, educating, training, communicating, hiring, and keeping talent. While the survey asked many questions about quality goals, measurement, and customer satisfaction, the most clear-cut consensus in the survey, the interviews, and the roundtable discussions were the issue of people. But electronics CEOs say employees are clearly the power behind any company's competitive edge and organizational excellence.

The survey asked CEOs to rank nine human-resource factors on importance in affecting their company's competitiveness. The number-one answer, with 73% ranking it most critical: a motivated, well-trained work force. Every industry segment except industrial electronics put the work force at the top of their list. By size, 85% of top-tier companies ranked the work force as their most critical competitive advantage.

After a motivated work force, the CEOs ranked qualified management as a competitive advantage. Among all companies, 62% ranked management as most critical. Only 51% of developing companies did so.

The CEOs had a lot to say about motivating employees. The methods range from the absurd (one CEO jumped into a vat of Jell-o in the company parking lot) to the sublime (another motivates by sharing the company financial statements with every employee). In the end, personal style becomes a very real factor in the race to hire the best and to motivate them.

For Peter Cherry president and CEO of The Cherry Corp., personal style is precisely what he looks for in his top staff. Says Cherry, "I'm not looking for someone who is book smart. I want someone who has that

Leon Machiz,
Chairman, CEO
and President,
Avnet Inc.

On reorganizing for efficiency...

"The biggest challenge Avnet faces is efficiency. Starting a few years ago, it was apparent that an aggressive posture with regard to efficiency was necessary. That was the reason I adopted the concept of 'hubbing.' I realized that just because we had a huge number of outlets, it didn't mean that we were necessarily structured correctly. Hubbing evolved as a result of addressing the bottom line and making sure that we're doing a sufficiently good job of keeping our suppliers happy.

"Hubbing just means moving out administration into centralized areas—centralized inventory, centralized product management, and centralized purchasing. There are two advantages: We can buy more effectively by buying in larger quantities and, by buying larger quantities, we found that we could collectively offer better terms.

"In looking at our organization, it was apparent that a number of facilities were not profitable. It also became apparent that we were really not allowing ourselves the advantage of critical mass. By being so disbursed we were, in effect, running a huge series of small businesses that didn't enable us to take advantage of centralized purchasing and centralized selling." ☐

Finis F. Conner,
Chairman and CEO,
Conner Peripherals Inc.

On management structure and style...

"I was determined to have a company that was successful, not because of how much one or two people contribute, but because it has multiple functions and multiple strengths. If you look at Seagate today there are two key people. And if either one left or was hit by a truck, where would they be? So our success is to continue to build. We have the most senior, successful managers in the business. But we can't stop, we have to add more...

"[The decision-making process is] a mixture of disciplines. We are not a traditional organization where everyone brings their argument to the party. We vote on it. And I have one more vote than everyone else. But neither are we so loose. Instead we talk about it. We have a group called the corporate management committee that has all the key individual contributors in it—Squires, Schroeder, Holt, Neun, Almon, myself. We bring that group together on anything that has to do with strategic direction. We have to meet and agree on where we are going.

"You have to have the trust and confidence [in each other]. I guess if there is one phrase to describe my management style it is mutual trust. I have to trust John Squires who knows more technical information than I ever will. If we are making a technical decision, he has the lead, he has one more vote. When it comes to an operations decision, we turn to Bill Almon. For marketing, Scott Holt. I have input into all those. If I think it is contradictory to what I think is right, I will try to convey my views and why. At the corporate management committee we are all equal. We have never had a situation, with the exception of one, where I had to make a decision contrary to the consensus." ☐

entrepreneurial spark; someone who is constantly challenging the organization and the status quo; someone who suggests improvement, whether it's a new technology in assembly, a new product, a new selling technique, or a new accounting method. That's the kind of person who gives the company its culture, its stature."

Keeping those key employees after you have found them is another matter altogether. During the '90s this issue will become even more critical as demographic trends point to a labor shortage of U.S. entry-level engineers and other young employees. Competition for the best employees is already cutthroat and most employees switch jobs much more often than the employees of 30 years ago. So electronics companies may buy fewer gold watches for the 25-year veteran, but the costs of getting and keeping good employees will be higher.

Corporate culture and stimulating, challenging work are paramount to keeping good employees. Most executives agree with Michael Cope, CEO of Interphase Corp. "Salary is way down the list in terms of attracting and retaining really qualified people," according to Cope.

For Robert Paluck of Convex Computer Corp., maintaining that special corporate culture takes a lot of work. "Maintenance of the culture is totally a function of the energy you pour into it," he says. "The whole driving force behind this is that you don't believe you can have an intensely happy customer unless you have intensely happy employees. You can't have one without the other."

Productivity pundits

Along with improving product quality, improving productivity remains a top goal with the CEOs who were interviewed. The success story of one large electronics company, Rockwell International Corp., inspires even the smallest electronics company. From 1980 to 1989 the number of people employed at Rockwell rose just 1,000, from 108,000 to 109,000. Yet over this same time period, revenue doubled.

Rockwell's COO, Kent Black, explains his productivity success story as "a lot of small ways of learning how to do things better and how to buy material better." One of Rockwell's improvements has been to set up a system of preferred buyers from whom Rockwell demands the highest quality.

By concentrating the buying power of all their operations into one corporate purchase agreement, by hiring purchasing people who are engineers, and by doing a multitude of small things better, Rockwell's productivity has soared. For example, at Rockwell's Tactical Systems Division in Atlanta, parts are no longer inspected on receipt; that responsibility belongs to the supplier. "In that way," says Black, "we've cut the hours to build a missile in half, and we've increased production about two and a half times. I think the head count in the division is down 40%."

The changing nature of the relationship with both suppliers and with customers has slowly but inexorably exerted its influence on the organizational structure of the electronics company. The trends of the '80s are changing the electronics company in the '90s: faster time to market; smarter, more quality-conscious consumers; increased foreign competition. The list continues on and on. But above all, the employee remains the key to the future success

Elton White,
Executive VP of marketing,
NCR Corp.

On project teams and decision making...

"For every new program, we put together a planning team which includes development, product management, and marketing. We put together what we call an integrated business plan which includes the marketing and development aspects. We've been doing this for about five years.

"NCR has had a management philosophy for some time that involves moving decision-making as far down the organization as possible. So one of the things we do is put together an organization that is responsible, that has a product charter. [The team] has a final decision on what the product should be that satisfies the market requirements. For that chartered area they have that responsibility. To facilitate this, we put together teams that work to get the right information and get the product to market fast. It's not the team's decision, but the organization's decision, on what the product is and the content of that product.

"So one of our objectives has been to move the decision-making down the organization. There are two conditions on that: [The decision maker] has to be at a level where the information is available to make that decision and at a level where the decision can be measured." ☐

Donald F. McGuinness,
Chairman,
Electronic
Designs Inc.

On empowering employees and cycle-time reduction...

"I think that management's role is to empower people and not much else. When the management gets involved and starts saying the way it should be, almost invariably the people say, 'Well, I'll show you another way it's going to be.' The Japanese are pretty good at it. Culturally they're better at team playing and getting together than our culture is. So the trick is empowering people constantly in the organization.

"The other issue is a cross-divisional issue. Take cycle time. Cycle time involves all of [the employees] together, from sales to accounting. But everyone looks at their own piece, and it can be very difficult to see how it fits in with the total picture. So the big issue for my company is how to manage across the departments, because that is where the big breakthroughs are. One partial solution to both problems is to set up some kind of reward system for our employees. This is what we are working on." ☐

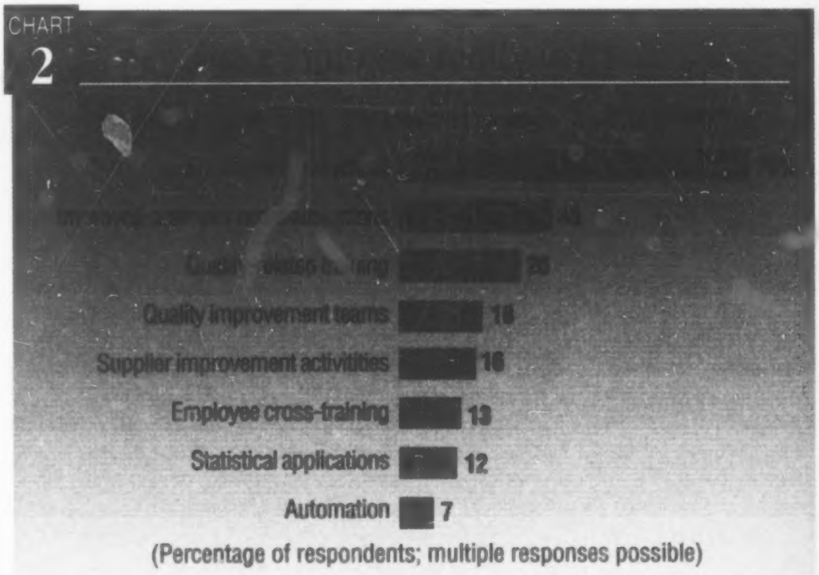
of the organization.

When asked which of eight techniques have been most successful in improving product quality, 76% of the survey respondents answered "employee involvement." The next most popular answer, with just 33% marking it as a most effective technique, was "improved customer communications."

With employee involvement so critical to the success of today's electronics company, training and education now rank as top priorities for the nation and the electronics CEO. Says Gary Tooker, president and COO of Motorola Inc., "There is a shrinking supply of technical talent, so one of the things we have to do is nurture the raw material. That's why we work on education. We spend about $60 million a year on education internally."

For electronics companies, which rely on a highly trained work force, the current state of the U.S. education system is a serious problem that many executives confront all the time. Some companies, like Motorola and Rockwell, have responded to the problem by increasing the amount of time and money spent on training. Others have begun more extensive testing of their work force before moving them into new positions that require more skills. And still others are importing their manufacturing engineers from abroad when they cannot find qualified American-born engineers.

CHART 2



(Percentage of respondents; multiple responses possible)

Frederick A. Krebbiel,
Vice chairman and CEO,
Molex Inc.

On the global employee...

"We need more people with global experience. Without it, Molex managers and employees are limited in their opportunities. You can only go so far up the ladder without international experience. It is expensive sending people overseas, but you have to do it.

"I worry about finding the right people to assemble the global network, making sure things fit together. Whenever possible, don't centralize your operations. It is too easy to lose flexibility with your customers." □

Talk is not cheap

In the electronics industry, change shapes every CEO's day. While more traditional industries react slowly to a changing global environment, the electronics industry itself is predicated on the value of rapid technological change. Anticipating, managing, and communicating that change is a big part of every CEO's job.

David Feldman, chairman and CEO of Ampro Computers, sees communication as paramount. Last year, after a trip to the Far East, Feldman decided he needed to make some basic changes in his company in order to compete. He came back from his trip, cut his company's price list from eight to two and a half pages, and rewrote the business plan.

But it didn't stop there. Next Feldman sent out the new plan to every manager in the company and requested their comments. Communication, both to and from the CEO, gets Ampro's employees intimately involved with the changes and the success of those changes.

For small, domestic companies, the task of communicating is ingrained in their corporate culture. James Donald, CEO of DSC says, "Employees can come see me any time they want." However, he admits, "It's getting a little bit more difficult these days because I can't find a place big enough to get everybody together every quarter."

Once the company gets larger and goes global, communication becomes a much more difficult task. For Robert Todd of Flextronics, the cost of communicating well is high because it necessitates frequent trips to see his operations and engineering staff in Asia. In fact, face-to-face communication remains key, say the executives, no matter where staff is located or how big a staff you've got.

CEOs of the larger electronics companies make it part of their job to find ways to get the benefits of size while minimizing the costs. For Rockwell International, that has meant eliminating excess management layers. For Cypress Semiconductor, nurturing smaller, focused business groups within the large corporation has been successful. For Motorola, cross-functional teams of engineering, manufacturing, and marketing has made communication more efficient.

Managing change and preparing their organizations to fight the business battles of the '90s, electronic industry executives have their work cut out for them. To survive, all CEOs will be striving for organizational excellence as never before. □

Taking the pulse of the ELECTRONICS INDUSTRY

BY ELIZABETH B. BAATZ

Nearly 600 top executives discuss their companies' performances last year—and how they plan to compete in the '90s

One morning in October 1990, more than 3,000 copies of the second annual ELECTRONIC BUSINESS/Ernst & Young CEO survey left the San Francisco post office bound for electronics companies across the United States. By the end of December, 582 valid surveys—a 19% response rate—had been returned to Ernst & Young's high technology group.

The eight-page survey dug out details about how top executives view their companies and their industry with respect to competitiveness, new technologies, management strategies, and organizational plans. With more than 250 questions per survey, Ernst & Young's data-entry group keyed in nearly 150,000 data points. The computer, guided by Ernst & Young's Kyle Kelhofer, did the rest. The results are presented here.

Who did we survey? All the executives on the mailing list are located in the United States. Only top executives were questioned, and only one reply per company was accepted. Despite diversity in the industry, market segment and company size and location were controlled so that the final data would roughly represent the U.S. electronics industry.

As in the 1990 CEO survey, all major markets are represented. The computer and peripheral industry accounts for 18% of the total number of responses; when weighted by revenue, this segment accounts for 37% of the total. Aerospace and defense companies represent 10% of the total number of responses but 36% of the survey group's revenue. The semiconductor and components industries account for 18% of the responses and 16% of the total revenue. Industrial electronics contributed 23% of the replies and account for 5% of revenue. Software makers chipped in 18% of the responses but only 2% of total revenue.

The details of the market segments covered in the survey are outlined in the table below. The major difference between this year's and last year's CEO survey: We moved semiconductor equipment manufacturers from the semiconductor grouping into the industrial electronics grouping in order to conform to common industry categories.

Differentiating market categories by which the data was cross-tabulated and cross-sectioned made many an Ernst & Young principal and ELECTRONIC BUSINESS editor cross-eyed. Indeed, defining the elusive, ever-changing electronics industry is an issue that plagues data crunchers in Washington, industry trade associations, and virtually every other data-gathering organization around the world. We simply tried to follow

CHART 1

A detailed look at the markets covered in the survey

	Number of companies	% of number	% of revenue	% of employment	Segment definition (percentage of respondents)
Industrial	134	23.1	5.1	5.1	Test and measurement (57%), semiconductor equipment (23%), factory systems (13%), medical (7%)
Computers	104	17.9	37.4	25.3	Peripherals (56%), computers (44%)
Components	103	17.7	15.8	31.6	Semiconductors (45%), passive components (18%), printed circuit boards (9%), other components (28%)
Software	102	17.5	1.7	1.8	Software developers (66%), CAE/CAD (25%), systems integrators (9%)
Defense	57	9.8	35.8	31.7	Aerospace, defense warfare systems, defense communications
Communications	48	8.2	1.6	1.6	Telecom equipment (54%), network systems (46%)
Other	34	5.8	3.0	2.9	Consumer electronics (5%), contract manufacturing, R&D, and miscellaneous manufacturing (95%)

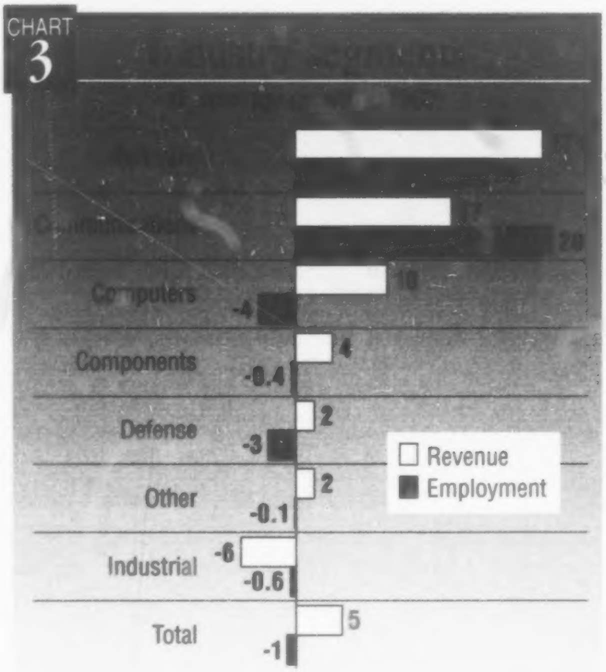
METHODOLOGY

the industry standards proposed by the American Electronics Association and the Electronic Industries Association.

More surveys, of course, were received from the smaller, more prolific developing companies (those with annual revenue of less than $25 million). The remaining 40% of the surveys received ranged from midsize companies with $25 million to $100 million in revenue to the top-tier companies with $300 million or more in revenue.

When categorized by type of funding, 22% of the surveys came from public companies, 59% from private companies, and 19% from subsidiaries. The public companies contribute 76% to the total revenue of the survey audience. Subsidiaries (of which 40% are foreign-owned) account for 18% of total revenue; the remaining 6% came from private companies.

CHART 3

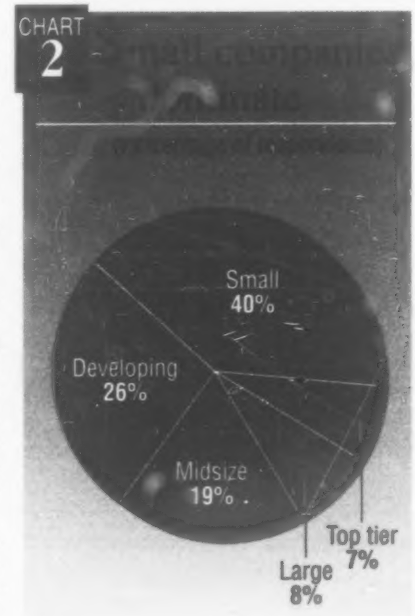


The 1990 survey also gleaned more information about recent company performance than the 1989 survey, giving us an idea of the business environment our CEOs are facing. In 1990, as expected, top executives were under intense pressure because of weak revenue growth; for the most part, management responded by cutting back employment—CEOs in most market segments cut their payrolls in 1990. Only software and voice/data communication companies were able to buck the trend and increase employment (by 21% and 28%, respectively).

The survey revealed some interesting trends. Revenue for the sample in our survey rose 5% in the latest fiscal year from the prior year. However, software makers report an average 27% increase in revenue and manufacturers of voice/data communications claim a 17% jump. Computer and peripherals saw a steady 10% gain.

Manufacturers of semiconductors and components, aerospace and defense electronics, consumer electronics, and other products experienced below-average revenue growth of between 2% and 4% compared with 1989; after inflation, in other words, these markets actually were coping with a declining revenue base. The industrial electronics market faced the largest revenue losses, with a 6% drop. The surveyed companies got 23% of their revenue from foreign sales, with computer/peripheral and industrial electronics makers capturing 27% and 29%, respectively, from offshore customers.

CHART 2



In any economic downturn, smaller companies generally are most susceptible to the perils of tighter credit, inflation, and business uncertainty. The 1990 results show the small companies are indeed under extreme pressure. CEOs from developing companies reported no revenue gains, while small companies watched revenue actually sink 21%. The surveyed companies who qualify as "top-tier" saw modest 4% revenue gains. Large company revenue rose 10% and midsize companies enjoyed a 21% rise.

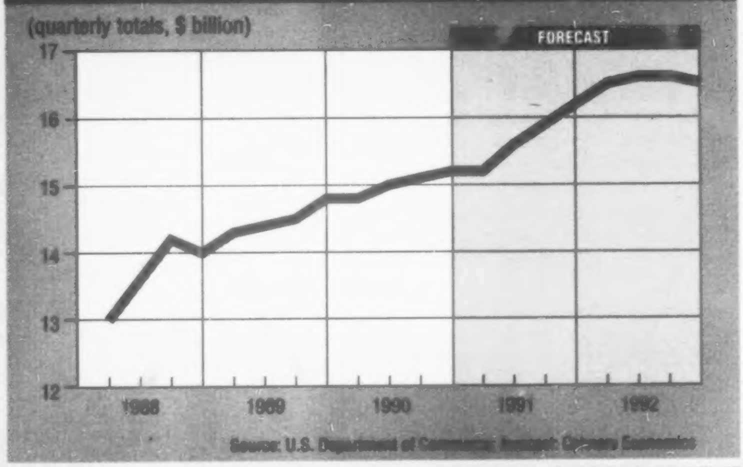
What do all these figures on companies' recent performance indicate? The recession was in its early stages when the CEOs filled out the survey, but most of the respondents had been managing slower growth during the past fiscal year. As a result, it would have been understandable if their comments about breaking into foreign markets, managing technological changes, and becoming quality-driven organizations had been tinged with an air of desperation.

Instead, many CEOs expressed unbounded optimism about their employees' skills, their companies' niches, and their industry's future. ☐

More details about this year's survey are available from Ernst & Young's high technology experts. You may obtain a complimentary copy of their report, *Electronics '91: Framework for a Winning Future*, by calling 800-3HI-TECH.

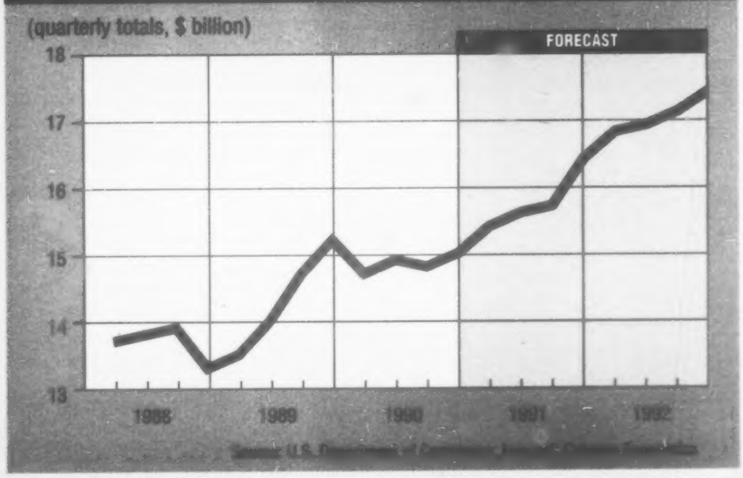
Did you miss out on the chance to participate in the CEO survey? Your comments and responses are critical. To add your name to our mailing list, please call ELECTRONIC BUSINESS at 617-558-4257 or Ernst & Young at 800-3HI-TECH.

Electronic component shipments



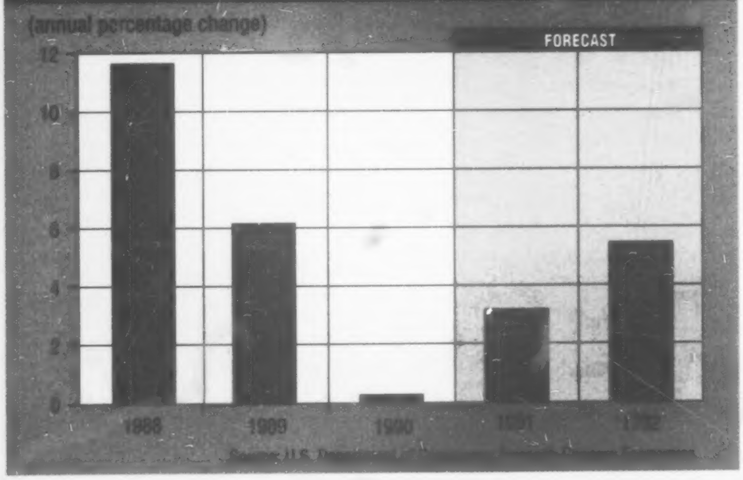
Source: U.S. Department of Commerce; forecast: Cahners Economics

Electronic component new orders



Source: U.S. Department of Commerce; forecast: Cahners Economics

Electronic component inventory growth



Source: U.S. [illegible]

Components demand seen rising in '91

Back in late 1989, hopes of an economic rebound loomed large when new orders for electronic components rose 14.5% above 1988 levels during the final quarter of the year—the strongest quarterly gain since the gangbuster growth rates seen in the first half of 1988.

Those hopes were dashed in 1990. The electronic component industry enjoyed only mild growth last year, which reflected the overall economic slowdown. New orders during the fourth quarter of 1990 dropped 1.1% from year-ago levels, to $15 billion.

Even with declining orders in the second half of 1990, however, a strong first half helped produce a moderate 3.3% gain last year. Despite declining orders in the fourth quarter of 1990, Cahners Economics predicts that new orders will grow slightly in the first half of this year as end-market demand from the computer industry slowly rebounds from a year-end slump. If the computer industry recovery does not materialize as expected, however—which is largely dependent on business confidence and the unpredictable course of the Persian Gulf war—the component industry downturn may continue.

Electronic component shipments exhibited slightly stronger-than-expected gains in the fourth quarter of 1990, growing 2.4% during the period compared with a year earlier. Shipments growth finished the year with an annual gain on par with new orders. Electronic component shipments rose 3.5% to $60 billion last year.

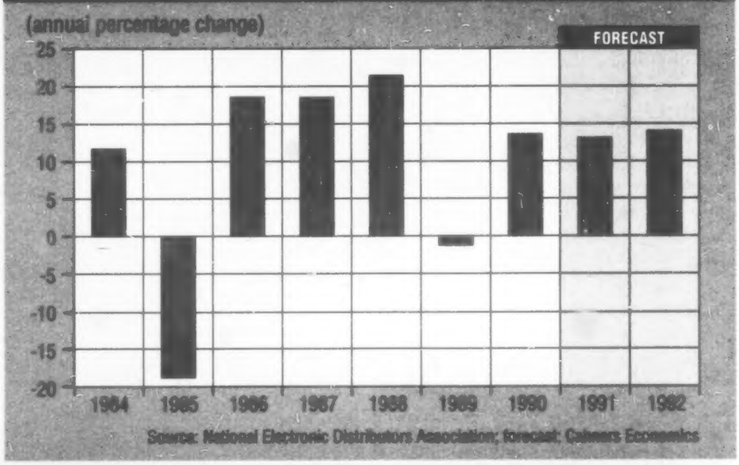
Over the past year, manufacturers have prepared for a slowdown by reducing inventory levels; that has helped the electronic components industry escape a more serious downturn this year. Compared with 1988, when inventories rose at double-digit rates, component makers grew their inventories just 0.3% in 1990.

It now appears that demand for components is on the rise, at least according to buyers. According to *Electronics Purchasing* magazine, delivery times for electronic components are stretching. Lead times stretched to 7.4 weeks this past February, up one week from a year earlier. Buyers' lead times generally rise first, before a turnaround in manufacturers' shipments.

Granted, this is scant evidence of a rebound. But if the war does not extend past July (as expected by two-thirds of the Bob Eggert's Blue Chip Panel of forecasters), the outlook for components isn't as gloomy as current news headlines imply.

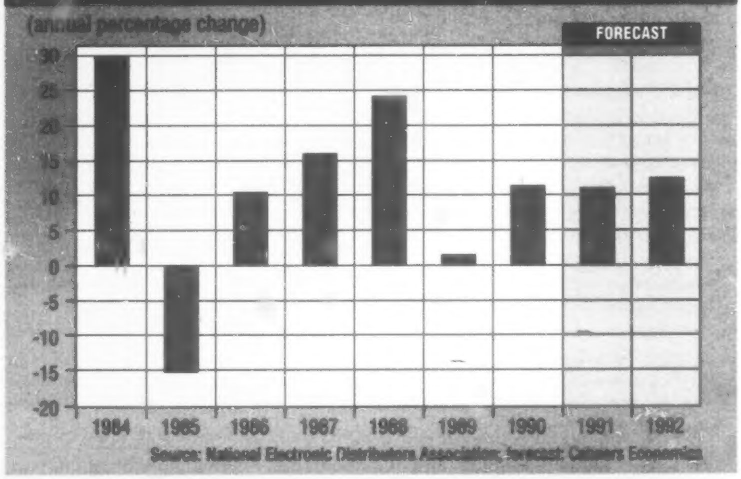
JULIE HANDELMAN

Electronic distributors' new orders



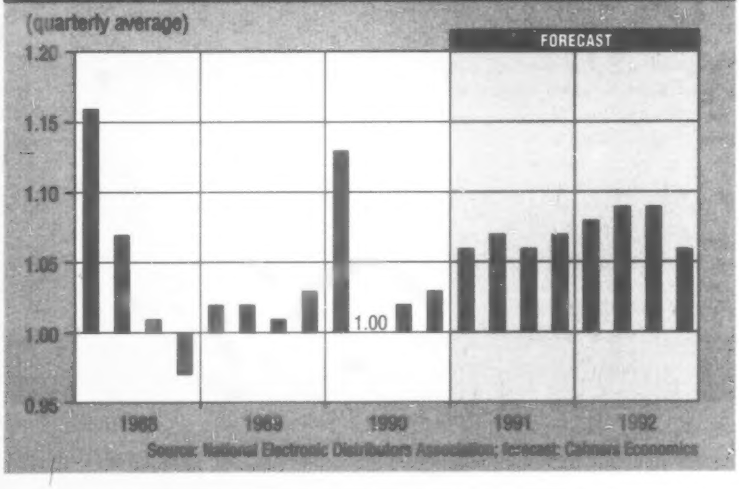
Source: National Electronic Distributors Association; forecast: Cahners Economics

Electronic distributors' shipments



Source: National Electronic Distributors Association; forecast: Cahners Economics

Distributors' book-to-bill ratio



Source: National Electronic Distributors Association; forecast: Cahners Economics

Distributors to see solid growth this year

Electronics distributors reported that new orders grew 9.6% above a year ago in the final three months of 1990. Although this quarterly gain is the weakest recorded since the third quarter of 1989, orders for all of 1990 made a healthy gain. According to the National Electronic Distributors Association, new orders swelled 13.7% above the 1989 level, on the heels of a 1.3% decline in 1989.

Does this mild softening in orders mean the distribution industry will begin to see sharp declines? The book-to-bill ratios suggest not. That ratio stood at 1.04 in December 1990, compared with 0.98 in December 1989. This is the sixth consecutive month the book-to-bill ratio has stood above 1.0, which means orders have been stronger than shipments. A ratio of 1.04 implies that for every $100 worth of products shipped, distributors received $104 worth of new orders. Cahners Economics expects the distribution book-to-bill ratio to stay above 1.0 in every quarter this year, averaging 1.06 for all of 1991.

Electronics distributor shipments inched up 3.1% from November to December 1990. During the final quarter of last year, distributor shipments rose 10.2% above the fourth quarter 1989 levels. Shipments for the entire year were slightly stronger than we had forecast, ending 1990 with an annual gain of 11.4%. Expect distributor shipments to continue rising this year, albeit at a slower pace.

Inventory control continues to act as a critical positive force for distributors. Because distributors have successfully held down inventory levels, they have been able to cushion themselves against the vagaries of war and economic uncertainty. With economic conditions looking brighter later this year due to lower interest rates and stronger business investment (assuming the Persian Gulf war has ended), distributors can expect both new orders and shipments to see strong gains by the end of 1991. New orders are forecast to rise 13.2% this year and 14.1% in 1992, while distributor shipments will swell 11.1% and 12.5%, respectively.

JULIE HANDELMAN

For more information on Cahners Economics' forecasting services, including seminars, newsletters, and database diskettes, contact Dan Buchan at (617) 630-2105, by fax at (617) 630-2100, or write Cahners Economics at 275 Washington St., Newton, MA 02158

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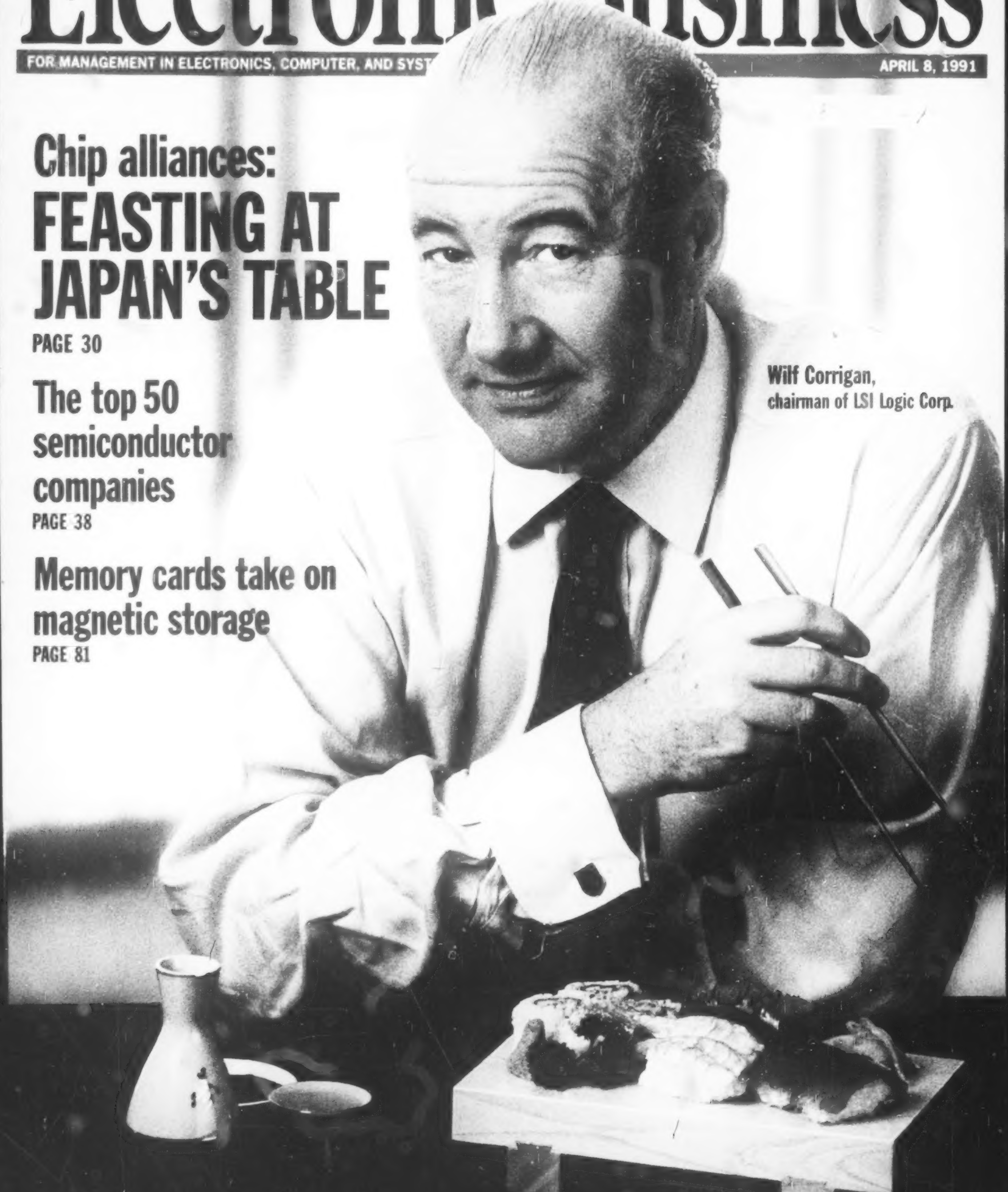

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Wilf Corrigan,
chairman of LSI Logic Corp.

Electronic Business

FOR MANAGEMENT IN ELECTRONICS, COMPUTER, AND SYSTEMS COMPANIES—WORLDWIDE

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APRIL 8, 1991

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COVER STORY/TOP SEMICONDUCTOR COMPANY

30 Why teaming up is so hard to do

The price of being a serious player in the world semiconductor market has gotten out of hand. For many U.S. chip companies, the only alternative is to find a deep-pockets partner, either at home or abroad. But some experts make the case that, since U.S. companies are so ill-suited for partnering, they often give far more than they get

Cover: Christopher Springmann

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TOP SEMICONDUCTOR COMPANY

30 Why teaming up is so hard to do

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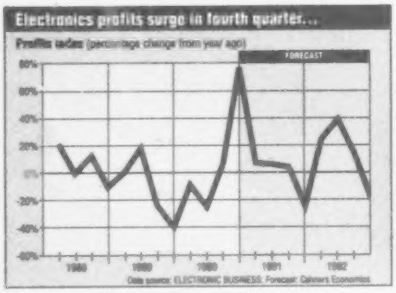

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What's your technology worth?

Contributing editor Valerie Rice: Are partnerships good for U.S. companies?

Remember the Old Testament account of the two women who both claimed to be the mother of a certain child? According to the story, King Solomon settled the dispute by ordering that the infant be cut in half and divided between the two women. He reasoned—rightly, as it turned out—that only the real mother would give up her claim rather than see the child destroyed.

For today's small U.S. technology company, that story has a familiar ring. Every year, untold numbers of entrepreneurs must choose between turning their precious, hard-won expertise over to strangers—usually large Japanese companies—and allowing the technology to die aborning for lack of funds.

The dilemma is by no means a new one. But we are no closer to a solution now than we were a decade ago, when Wilf Corrigan traded his know-how for financing via a Japanese partnership. Was it a good swap? Corrigan thinks so, since it was the only way that his semiconductor company—LSI Logic Corp.—could get off the boards. But as contributing editor Valerie Rice writes in "Why teaming up is so hard to do," others are more skeptical. Some say that such partnerships are at best ineffective; at worst, they arise from a fundamental weakness within the U.S. electronics industry and in effect do little more than bolster the technological arsenal of our toughest technological competitors.

In this case, the answer almost certainly lies somewhere between these two extremes. But one also must wonder if anyone is even arguing about the real issue. Perhaps the point of contention is not whether U.S. companies are striking good deals with their Japanese partners (some are, some aren't), but why they're being forced to take up partnerships in the first place.

We've heard most of the stock answers: impatient investors, the high cost of capital, and the lack of an industrial policy (what *is* industrial policy, anyway?) in Washington that supposedly puts U.S. electronics at a severe disadvantage vis-a-vis Japan and Western Europe. But Rice notes an even more damning reason: U.S. companies are notoriously poor students who are often more intent on parading their R&D than in learning how to manufacture efficiently. If she's right, we'd better get used to the idea that we are doomed to be forever choosing between technological infanticide and selling our offspring to the highest bidder.

This time, even Solomon's wisdom might not be able to help.

H. GARRETT DeYOUNG, managing editor

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nouncements from DEC and HP, endorsements have been received from Unisys Corp., Oki Electric Industry Co., DuPont Co., ITT, and a smattering of smaller bus component vendors. Still, the best guesses of industry observers are that Futurebus+, in whatever form it takes, will not be around as a working bus for at least another two years. The question is, if VME and Multibus II still provide adequate performance for a fraction of the cost, will anyone care?

DAVE WEBB

IPOs

Venture capitalists take stake in software

IF 1990 PERFORMANCE is any gauge, electronics, computers, and software still rank highly with the venture-capital industry. While last year's IPOs didn't keep the venture crowd as busy as they would have liked, the electronics industry at least kept the money moving.

Of the 42 companies that went public last year, 12 were computer-related—9 in software and services and 3 in hardware and systems, according to Venture Economics Inc. of Needham, Mass.

That continues a trend among investors that began five years ago. Between 1986 and 1990, electronics-related companies accounted for 45% of all IPOs. The number was 46% in 1989 and reached 50% last year.

Tempering that trend is the fact that for all industries, total venture-capital disbursements during the first half of 1990 plummeted 47% compared with the first half of 1989. One reason that electronics fared so well among IPOs in 1990: Software hit it big. Total capital provided by the venture community to software companies grew 2% in the first half of 1990 compared with the first six months of 1989. As a result, new offerings by nine computer software and services companies last year reached $236 million, compared with just four IPOs worth $84 million during 1989. In fact, software was the only industry to see an increase in total venture capital disbursements, says *Venture Capital Journal* editor John Bonnanzio.

Still, last year's stock market provided plenty of white-knuckle flying for venture capitalists. From the date of the stocks' IPO to Dec. 31, 1990, the composite price of the 42 new venture-backed issues slid 8% during the year. The best performers, however, beat the trend with an average stock price increase of 25% by concentrating on such fundamentals as low debt and attractive P/E ratios. The worst stock price slides—those with a decline of more than 40% between their IPO and year-end—hit five communications companies, a software company, and a producer of simulation systems used to design integrated circuits.

ELIZABETH B. BAATZ

The best and worst IPOs

(percentage change in stock price from date of IPO to Dec. 31, 1990)

Company	IPO date	Business	% change
The best:			
Cisco Systems Inc.	2/90	LAN interconnect	149.3
Marcam Corp.	8/90	CIM software	78.6
Micrografx Inc.	6/90	graphics software	59.4
Easel Corp.	8/90	software tools	43.8
Xilinx Inc.	6/90	gate arrays	37.5
RasterOps Corp.	5/90	graphics systems	31.3
Integrated Systems Inc.	3/90	CAE/CASE software	30.6
Alias Research Inc.	7/90	design software	25.0
The worst:			
Digital Sound Corp.	2/90	phone message systems	-82.4
IKOS Systems Inc.	7/90	electronic design	-66.3
Syntellect Inc.	3/90	voice response systems	-53.3
Telebit Corp.	4/90	modems	-51.3
Aspect Telecommunications	5/90	telephone systems	-50.0
MECA Software Inc.	7/90	PC software	-45.0
Sequoia Systems Inc.	7/90	computer systems	-44.7

Source: Venture Economics Inc.

HIGH-TECH

Zenith unveils a big-time bodyguard

WHEN NYCOR INC., an investment company set up by air conditioner-maker Fedders Corp. of Peapack, N.J., launched a proxy fight against the management of Zenith Electronics Corp. on Jan. 10, there was a distinct possibility that America's best hope to play in the high-tech TV business of the future would fall into the hands of low-tech appliance manufacturers. After all, Zenith—the last U.S.-owned manufacturer of color TVs—had lost $169 million since 1985, had dumped its profitable computer business in 1989 to stem a flood of debt, and had overseen the fall of its stock price from $30 in mid-1988 to around $7 in early 1991. So Nycor's claim that Zenith lacked a coherent strategy for recovery was bound to strike a chord with some investors.

But with stockholders set to vote on the subject on Apr. 24, Zenith got some heavyweight help from an unlikely source—Goldstar Co., the $5 billion subsidiary of $30 billion behemoth Lucky-Goldstar Group of Seoul, South Korea. Not only did Goldstar agree to buy 4.97% of newly issued Zenith stock—at a 50% premium over the going market rate—but the company also inked two technology agreements bringing Glenview, Ill.-based Zenith's long-term strategy into much clearer focus.

The first deal gives Goldstar license to make and sell Zenith's patented "flat tension mask" displays, a CRT-like assembly that features a flat, rather than curved, viewing surface resulting in heightened contrast and reduced glare. Licensing fees alone will be "in the multimillions" of dollars, says Zenith's John Taylor.

The second agreement is a ringing endorsement of Zenith's high-

Inside the top 50 worldwide chip companies

Who's on top? Japan, of course. But there's a lot more than meets the eye behind the top 50 semiconductor company ranking for 1990

BY ELIZABETH B. BAATZ AND LINDA STALLMANN

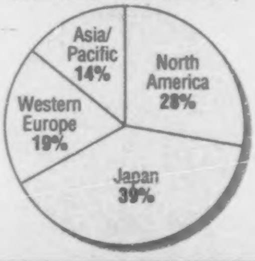
There are no surprises on our 1990 ranking of semiconductor companies: As far as merchant integrated circuit manufacturing is concerned, the top three companies hold precisely the same spot they had in last year's list. Japan's NEC Corp. is ranked the number-one company with Toshiba Corp. in the number-two slot and Hitachi Ltd. as number three. According to the leading semiconductor list makers—Integrated Circuit Engineering, Dataquest, and In-Stat—Japan's dominance at the top of the largest semiconductor company lists is a well-known fact. This year, with the help of ICE, ELECTRONIC BUSINESS has delved deeper into the semiconductor list, and the facts that lurk behind the "who's on top" headline are revealing.

Japanese semiconductor companies make more ICs in the merchant market than any other nation. In 1989, 17 Japanese companies accounted for 54% of all merchant IC sales, according to our list, a fact that is astonishing and to some a frightening testimonial to the preeminence of Japan's semiconductors. But even Japan's powerhouse semiconductor makers saw their share of worldwide sales fall in 1990 to 52%.

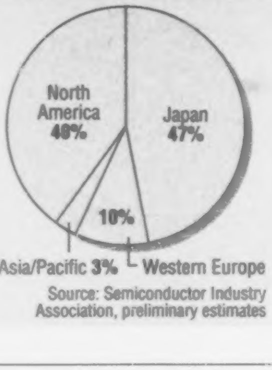
Last year was not a great year for Japan's semiconductor industry. Manufacturers—who have relied too heavily on dynamic random access memory chips—could not stem the bleeding as DRAM prices plummeted. Also Japan's export growth slowed, and domestic demand didn't make up the difference entirely. As a result, IC sales by the top Japanese manufacturers rose just 3% last year. (Measured in U.S. dollars, their sales fell 2% as the value of the yen weakened.) Number-one NEC managed to buck this trend by growing merchant sales 5.5% in yen last year.

Where semiconductors are consumed...

(percentage share in 1990 $50.5 billion worldwide sales)



...and who sells the chips



Source: Semiconductor Industry Association, preliminary estimates

In the face of Japan's market share stranglehold, is there hope for U.S. semiconductor companies? The top 50 list suggests there may be more hope than the nation's doomsayers suggest. Twenty-two U.S.-owned semiconductor companies made it onto the top 50 list in 1990. They accounted for 35% of the top 50's total sales, up from 34% the year before. And while Japanese sales were taking a hit from falling memory chip prices, the top 10 U.S. companies managed an overall 9% gain despite a slump in military IC demand. Strength in the microprocessor market ensured above-average sales growth for the two leading U.S. companies, Intel Corp. and Motorola Inc.

According to San Jose consulting company, VLSI Research Inc., another positive trend—the emergence of mixed-signal ICs—bodes well for the U.S. companies' future. VLSI Research president G. Dan Hutcheson says mixed-signal ICs will be to the '90s what application-specific ICs were to the '80s and microprocessors and memory chips were to the '70s. (Hutcheson defines mixed-signal devices as those in which both analog and digital functions are built onto the same chip in any proportion.) The five leading mixed-signal IC suppliers in the world now are U.S.-owned companies, and these five also have sizable mixed-signal export sales to Japan. NEC doesn't enter the top 10 mixed signal-IC list until position number 7, says Hutcheson.

Across the Atlantic Ocean, six European companies made it onto the top 50 list, although the first on the list, Philips/Signetics, didn't reveal itself until position number 12, and SGS/Thomson/Inmos stood at number 13. Sales of Europe's six leading IC makers, when measured in U.S. dollars, garnered the multinational team 9% of total sales of the top 50, up from an 8% share the year before.

The two largest European semiconductor companies accounted for nearly 60% of all merchant IC sales made by European-based companies. This trend toward consolidation, with the prospect of one single European market looming in 1992, will no doubt continue among European companies during the next decade. Compared with Europe, the concentration of semiconductor sales in the top two companies is much lower in both the United States and Japan—with the two largest U.S. companies accounting for just 36% of all U.S.

sales and the top two in Japan accounting for 33%.

The newcomers to the top 50 semiconductor maker rankings are the Asian Pacific companies. In 10th place, South Korea's Samsung Electronics Co. ranked highest among its compatriots and Pacific neighbors. Two more South Korean and two Taiwanese companies round out the list. Together the Asian Pacific companies account for the final 4% of the $45 billion in sales by the top 50 largest merchant semiconductor companies.

In the '90s these regional distinctions will become more and more important to the governments and perhaps less and less important to the large chip companies of the world. As Japan looks for partners and purchases in the United States and Europe, U.S. companies will ally with partners in the Pacific and across the Atlantic. Who's on top? Depending on who owns what, where the chip is made, and who licenses the technology, the answer will become increasingly shrouded in the multinational fog every year. ☐

Definitions:

Companies are ranked by IC sales only (does not include discrete semiconductors).

Merchant semiconductor sales do not include U.S. captive (e.g. IBM, DEC, etc.) production.

All figures that describe "sales by geographical headquarters location" include all sales by a company regardless of where the product is produced or sold. All of Texas Instruments' semiconductor sales, including those from its Japanese and European facilities, for example, are listed under North American semiconductor sales.

Percentage change figures were calculated from sales data as measured in the local currency where the companies' headquarters are located. For example, the Japanese and Asian Pacific currencies weakened against the dollar from 1989 to 1990. As a result, the percentage change figures are higher in the local currency than they would have been if translated into U.S. dollars. The European currencies strengthened against the dollar, so the reverse is true.

Top 50 semiconductor companies

Rank	Company	1990 Sales ($ million)	% change* 1990/1989	Location
1	**NEC**	$4,145	5.5%	Japan
2	**Toshiba**	3,570	1.4%	Japan
3	**Hitachi**	3,205	2.7%	Japan
4	**Intel**	2,915	20.0%	N. America
5	**Fujitsu**	2,765	-0.7%	Japan
6	**Motorola**	2,750	9.3%	N. America
7	**Texas Instruments**	2,715	0.0%	N. America
8	**Mitsubishi**	2,035	-0.1%	Japan
9	**National Semiconductor**	1,611	6.0%	N. America
10	**Samsung**	1,335	13.4%	Asia/Pacific
11	**Matsushita**	1,285	11.6%	Japan
12	**Philips/Signetics**	1,175	-14.2%	Europe
13	**SGS/Thomson/Inmos**	1,175	-1.1%	Europe
14	**OKI Semiconductor**	1,100	2.3%	Japan
15	**Advanced Micro Devices**	1,050	-2.8%	N. America
16	**Siemens**	1,000	2.0%	Europe
17	**Sharp**	975	1.4%	Japan
18	**Sanyo**	955	2.4%	Japan
19	**Rohm**	780	7.8%	Japan
20	**AT&T**	725	1.4%	N. America
21	**Sony**	720	3.6%	Japan
22	**Harris**	655	-5.8%	N. America
23	**Western Digital**	575	19.3%	N. America
24	**LSI Logic**	540	18.9%	N. America
25	**Seiko Epson**	535	10.2%	Japan
26	**Fuji Electric**	400	5.1%	Japan
27	**Analog Devices** [1]	366	35.6%	N. America
28	**VLSI Technology**	300	15.4%	N. America
29	**Micron Technology**	295	-6.3%	N. America
30	**GEC Plessey**	270	7.8%	Europe
31	**Hyundai**	250	1.3%	Asia/Pacific
32	**Cypress Semiconductor**	235	18.1%	N. America
33	**NMB Semiconductor**	220	-5.6%	Japan
34	**ITT**	210	-10.3%	Europe
35	**Integrated Device Technology**	200	-2.4%	N. America
36	**United Microelectronics**	180	41.1%	Asia/Pacific
37	**New Japan Radio**	180	8.1%	Japan
38	**Yamaha**	175	8.2%	Japan
39	**Silicon Systems** [2]	170	36.0%	N. America
40	**Ricoh**	170	2.1%	Japan
41	**Burr-Brown**	145	6.6%	N. America
42	**Goldstar**	141	21.8%	Asia/Pacific
43	**NCR**	125	4.2%	N. America
44	**Atmel**	125	23.8%	N. America
45	**Telefunken**	120	-13.3%	Europe
46	**Allegro** [3]	116	NA	N. America
47	**Gould AMI**	115	-4.2%	N. America
48	**Zilog**	105	9.4%	N. America
49	**Dallas Semiconductor**	100	22.0%	N. America
50	**Taiwan Semiconductor**	100	32.3%	Asia/Pacific
	Total	$45,104	3.1%	

1 Includes Precision Monolithics for 1990
2 Purchased in 1989 by TDK
3 Formerly Sprague Semiconductor, owned by Sanken Electric

NA = Not available
* in local currency
Source: ICE Corp.

Taiwan's PC makers at the workstation crossroads

Five Taiwanese companies are in the market now, and others are poised to join them. But the field may be too crowded

BY RUSS ARENSMAN

Stroll through the showroom at the Tatung Co. headquarters in downtown Taipei and you'll see relatively few high-tech products. There is an area devoted to PCs, but most of the showroom is filled with refrigerators, ovens, and electric fans.

Tatung's merchandise illustrates its predicament—the company owes its position as Taiwan's largest electronics company more to older technologies like electric motors and compressors than to expertise with emerging technologies like semiconductors and computers. Moreover, their profit margins have been squeezed even further in recent years by the appreciation of the new Taiwan dollar. For Tatung, the net result is that, after years of steady growth, the company's sales flattened in 1990 at $2.1 billion, virtually the same as the previous year's.

Company officials hope to revive Tatung's growth by focusing on the technology-intensive—and potentially more profitable—electronics market. Tatung already has become Taiwan's largest PC monitor manufacturer, and its sales of PCs and computer-related equipment have increased from virtually nothing a decade ago to about one-third of its current revenue.

But even the PC market is becoming difficult, concedes Tatung president W. S. Lin, especially at the low end. As a result, the company has set its sights on the logical next step in its product evolution: workstations.

Tatung certainly isn't the only Taiwanese company interested in workstations. Four other of the island's electronics companies—Sampo Technology Corp., Datatech Enterprises Co., Chicony Electronics Co., and Twinhead International Corp.—plan to enter the market, and several others are considering the move. Sampo is part of a large manufacturing group that, like Tatung, is trying to move beyond appliances into more sophisticated electronic products. The other three are smaller, younger companies that started building video games and PC products during the past decade.

Despite their differences, all of them see workstations as an opportunity to diversify and gain a foothold in a young, fast-growing market. Tatung, however, appears to be making the biggest commitment to the workstation market and, to date, has made the fastest progress in developing a product line. Nearly two years ago Tatung engineers in Taiwan and California started developing workstation designs from Sun Microsystems Inc.'s scalable-processor architecture (Sparc) technology. By last August they were ready to announce the first Taiwan-made Sparc workstation, called the Mariner 4i.

Lin, whose grandfather founded Tatung as a construction company in 1918, expects workstations to become one of the company's biggest growth areas in coming years and estimates the company will sell 6,000 units in 1991.

According to Dataquest Inc., workstations represent the computer industry's fastest-growing market segment. The San Jose research firm forecasts worldwide workstation sales revenues will grow by more than 20% a year through the mid-1990s,

Tatung's president W. S. Lin is setting his sights on the next logical step: workstations

from $7.4 billion in 1990 to $20 billion in 1994. Most of the computer industry's major players—including Hewlett-Packard Co. and Digital Equipment Corp.—are trying to take business away from the market leader, Sun Microsystems, which claimed nearly one-third of all workstation shipments and revenue during 1990.

Sampo's Martin Wu says the company plans to develop more powerful models before year's end

Recently the market began to attract a crowd of new contenders. At last count, analysts expected at least 30 companies, many of them from Taiwan and Korea, to enter the workstation market in the next year. Most of the Asian companies hope to repeat strategies that fueled the phenomenal growth of the Taiwanese PC industry during the 1980s—this time building clone workstations. And instead of Intel microprocessors and MS-DOS software, most of the workstation clone makers plan to license Sun's Sparc microprocessors and its proprietary Unix operating system, which will allow their machines to use the roughly 2,800 software applications already developed for the Sparc market.

Most analysts don't expect the clone makers to make a big dent in the market initially. Workstations require a different sales strategy and distribution channel than PCs. While PC buyers are usually content to buy machines from retail outlets, most workstation buyers expect more support in areas like setting up their system and training employees.

David Hoffman, a research analyst for the Taiwanese consulting firm Investec (Taiwan) Ltd., says the biggest challenge for Taiwan's workstation clone makers will be marketing. "The companies here develop good products," he says. "But can they market them?" Hoffman doubts any of the current Taiwanese workstation makers know enough about workstations or international marketing to succeed in such a competitive business.

The optimists guess that perhaps 30,000 Sparc-compatible clone machines will be sold this year. But in a few years, the impact could be more substantial. Fujitsu Microelectronics Inc., which hopes to sell Sparc chip sets to many of the clone makers, projects that by the end of 1993, Sun-compatible clones will comprise 16% of the worldwide technical workstation market, generating $2.9 billion in revenue.

Sun has been licensing its Sparc technology since 1987. But licensing and royalty fees were expensive, and until recently licensees had to figure out how to build many of their own Sparc chips. Last year, however, Sun decided to encourage clone makers by allowing its semiconductor suppliers—including Fujitsu, LSI Logic Corp., and Cypress Semiconductor Corp.—to sell complete Sparc-compatible chip sets.

What counts is not making the workstations but selling them

"Until then nobody wanted to pay Sun $2 million, and nobody had the 50 engineers and two-year lead time to develop their own solution," says Ron Jankov, the former general manager of LSI Logic's sales office in Taiwan.

Thanks to the chip set vendors, Sparc clone makers finally arrived in force at last November's U.S. Comdex computer show. About a dozen companies, including all five of the Taiwanese clone makers, announced workstations based on LSI Logic's 20 megahertz Sparc chip set.

LSI Logic won orders from most of the early clone makers by helping them enter the market quickly with a start-up kit that includes a compete circuit board design and all the software needed to build workstations compatible with Sun's SparcStation 1 machines.

But observers doubt that there will ever be a large market for 20 MHz machines based around the LSI Logic chip set—too many companies have signed up to make essentially the same product, which lost much of its appeal last summer when Sun introduced its more powerful 40 MHz SparcStation 2 line.

But for many clone makers, the LSI Logic chip set was the best way to get an early start. "In the beginning I didn't have much choice but to use the 20 MHz products," according to Martin Wu, marketing director for Sampo. "Sampo needed something to just get started with." The market for the initial 20 MHz machines may turn out to be relatively small, he concedes, but Sampo plans to develop more powerful models before year's end.

Archie Yeh, a researcher with the Taiwanese government's Computer & Communications Research Laboratories (CCL), says he is worried that so many of the Taiwanese clone makers are building similar machines. "You will see a very crowded market, which will drive profit margins down very fast," warns Yeh.

Although Sun has encouraged clone makers to license its Sparc technology, Sun isn't an easy target for clone makers to compete against, says Justin Tsay, workstation marketing manager for Twinhead. "Sun is pricing very aggressively in the low-end market," he says. Twinhead and other clone makers initially hoped to win over Sun customers by pricing their workstations 20% or 30% beneath Sun's equivalent models. But to date, Sun's relentless price cutting has made it difficult for clone companies to even match its prices.

As a result, Twinhead has yet to decide whether to put a workstation based on LSI Logic's 20 MHz chip set into production—even though it has licensed the technology.

Adding unique features and capabilities is one of the best ways for clone makers to take advantage of profitable niche markets while avoiding the brutal price competition of the commodity workstation areas. Most of Taiwan's companies appear to be taking steps in that direction. Datatech, for example, has developed a 25 MHz workstation based on Cypress Semiconductor chips that is currently the only Taiwanese-made clone to use a Motorola-type VME system bus instead of the usual Sun S-bus to handle expansion and enhancement products.

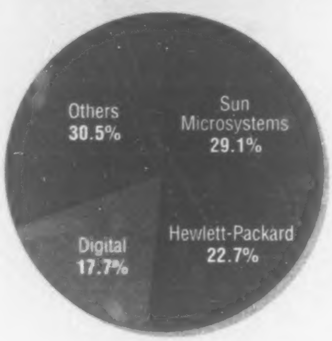
Another differentiation strategy comes from Tatung, whose Mariner 4i workstation offers an optional DOS coprocessor board. The board is equipped with an Intel 25 MHz 80386 microprocessor, VGA graphics capability, and cache memory, allowing users to operate IBM-compatible DOS software without leaving the Unix window environment or compromising the performance of the PC software. Tatung officials say 80% of the early Mariner systems shipped have been equipped with the DOS coprocessor.

Both Tatung and Datatech hope to begin production by 1992 of another workstation design developed jointly with CCL. They are the only two surviving members of a workstation consortium started by CCL in early 1989 for the purpose of making Taiwan a major force in the workstation industry. Four other Taiwanese electronics companies—including the country's largest PC maker, Acer Inc.—were originally invited to join the consortium. But Acer, Copam Electronic Corp., and two smaller companies quickly dropped out of the project after PC industry giants Intel Corp. and Microsoft Corp. pressured them to stay away from the Sparc clone business.

Microsoft president Bill Gates and Intel vice president Albert Yu flew to Taiwan to lobby companies against joining the Sparc consortium, which suggests how threatening the idea may have been to the U.S. companies: The last thing Intel and Microsoft wanted to see were their largest customers defecting to the Sparc camp.

Coveting a piece of Sun's market share

1990 worldwide workstation market factory revenue= $7.4 billion



Source: Dataquest Inc.

CCL officials say that before Intel and Microsoft exerted influence, Acer was the most enthusiastic member of the workstation consortium. Despite its withdrawal from the workstation business, many in the industry wonder how much longer Acer will be willing to stay out. CCL official Yeh notes that virtually all of the major Korean PC makers have announced plans to expand into workstations and have aligned themselves with either Sun or another major workstation vendor.

Workstation sales growth will top 20% a year through 1994

Acer vice president Kwan G. Tan, who left Sun two years ago to spearhead Acer's workstation development effort, says that Acer officials are still weighing whether it makes sense to enter the workstation market. "We are interested, but we're still investigating what sort of workstation we should break into," he says.

Tan worries that too many Asian companies are moving into the Sparc-clone business. "We are concerned that there isn't much room for the clone maker to make a profit, especially when Sun's price is coming down continuously," he says.

Tan, who helped develop the first Sparc workstation and chip set when he worked at Sun in the mid-1980s, says Acer will have no trouble developing a product line in a hurry if it decides to enter the market. "It's not making the workstations per se, it's how you sell them," he remarks. "This is really a channel/distribution problem. Any company that doesn't solve that problem won't make money."

"Acer is the only company that will do it, and I think they took the right approach by buying Altos," says Investec's Hoffman, referring to Acer's 1990 purchase of Altos Computer Systems, the troubled U.S. Unix multiuser systems maker. Hoffman contends that if Acer substitutes workstations for Altos's current product line, it could use the company's existing distribution channels, support staff, and customer base as a launching point into the Unix workstation market. When Acer bought Altos, he says, "basically it bought a channel."

CCL's Yeh agrees there is still time for Acer to make an impact in the workstation market. But for now, he picks Tatung as the Taiwanese workstation clone maker with the best chance for success because of its sheer size and apparent willingness to invest heavily to establish a foothold in the market. Yeh also believes that Twinhead has a strong engineering team with expertise in software and chip design.

But until they actually begin building and selling large numbers of workstations, it remains to be seen how serious Taiwanese companies are about competing in the workstation market. For all of them, workstations are still far from becoming major money makers. The test of their commitment will come the next time Sun cuts its prices.

Wu concedes that Sampo is being cautious about its own spending on workstations. "This is still a young market, and it will take more time to develop. But if it progresses like the PC market, then we have to be a player as early as possible." ☐

Workstations take on the commercial marketplace

Vendors are pushing commercial systems applications to sustain the momentum built up by technical users. There's plenty of room for growth

BY DAVE WEBB

Faced with flattening demand for technical applications, it was just a matter of time before the giants of the workstation market would zero in on the potentially huge commercial systems market.

That time has come. With unit sales to commercial users pegged to grow some 60% by 1994, Sun Microsystems Inc., Hewlett-Packard Co., IBM, and Digital Equipment Corp. have all mapped out battle plans for carving up the market.

Sun already claims a bevy of early-adopter commercial customers, including the New York Stock Exchange, Citibank Corp., Shell Oil Co., AT&T, Northwest Airlines, and Shearson Lehman Hutton Co. HP recently landed impressive sales to Wal-Mart Stores Inc. and U.S. West Inc. for commercial workstations, and nearly every major U.S. computer vendor has commercial image-processing system marketing plans that involve workstations as key components.

Sales are being propelled by the demand for relatively inexpensive, powerful, small-footprint "open" systems. The workstations' price/performance curves have reached the point at which they can compete in the commercial market: Workstations can now be had for as little as $5,000 and solution packages are less than $15,000—much cheaper than minis, which start at $18,000 and climb to $150,000.

"Workstations are now more than just an engineering tool," says Mark Tolliver, marketing manager for Hewlett-Packard's workstation group in Sunnyvale, Calif. And analyst Vicki Brown at International Data Corp. in Framingham, Mass., gushes, "Workstation memory, performance, power—all that stuff—is going up, up, up. People are thinking, 'Should I bring my mainframe or mini down to a distributed desktop?' And it's not just engineering people anymore."

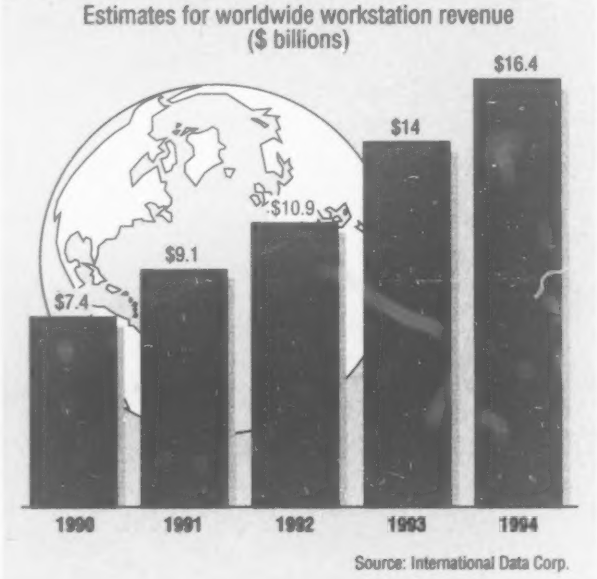
The impact is being felt most in the minicomputer segment, where workstation vendors have long since seized a major share of the technical market. DEC, Data General Corp., Prime Computer Inc., and Wang Laboratories Inc. have all seen eroding mini sales and are now pushing their nonproprietary open-architecture workstations to head off further erosion in market share and revenue.

The emergence of the workstation as a business machine also could hurt PC suppliers. While vendors of desktop systems based on CISC—the hazy distinguishing characteristic between a high-end PC and a RISC workstation—migrate to faster, more powerful computers, those machines still lack the graphics and multiprocessing capabilities that workstations offer at marginally higher prices.

Distributed, so-called client/server PC architectures would be the heaviest area of competition. But some industry observers question the degree to which workstations and PCs will compete for commercial applications. Lorie Strong, vice president of marketing at Compaq Computer Corp. in Houston, is only slightly concerned about the encroachment of workstations on the commercial market. For their part, workstation vendors play down the PC's productivity advantages, which are bolstered by dozens of popular, widely available software packages. At Mips Computer Systems Inc. in Sunnyvale, marketing vice president Joseph DiNucci regards PC applications as incidental add-ons to larger, enterprisewide applications. "We'd love to have Lotus [1-2-3] and WordPerfect on our platform, but we don't need to sit in their lobbies with hat in hand to listen to what they want," he says.

One thing everyone

Continued growth for workstations



Source: International Data Corp.

agrees on: The $7.4 billion workstation market will continue to flatten if vendors stick to conventional technical applications. Sales pegged exclusively to technical users have recently grown by less than 20% a year, according to Gary Little, Sun's manager of industry marketing in Mountain View, Calif. By breaking into the commercial market, suppliers hope to return to the blistering growth rates once posted in the technical arena. "Workstation vendors can't keep growing as fast as they've been growing without opening up this kind of market," says IDC's Brown.

If the breakthrough in commercial applications occurs, sales could rocket: Dataquest in San Jose figures that by 1995, workstation vendors will be raking in $23 billion in worldwide revenue, mostly from the commercial market. Sun, for example, wants to boost its workstation growth rate to 40% a year, says Little. The company predicts that by 1993, its business will be divided evenly between technical and commercial systems products.

Sun has made the most noise about targeting the commercial marketplace, but most workstation vendors have charted some sort of commercial systems strategy. Most of Sun's Sparc architecture system manufacturers are also scoping out the commercial arena.

IBM's RS-6000 is gaining recognition as a commercial (versus purely technical) machine, for example, and a slew of Mips-design OEMs—Bull S.A., Prime, Wang, DEC, and Control Data, to name the larger ones—have made their intentions clear about marketing workstations in nontechnical applications. Next Inc. in Palo Alto, which revamped its product offering last year, is one of the few companies targeting commercial applications exclusively and should become a powerhouse player with its user-friendly applications. "In any emerging market there's always room for one newcomer to compete with the big guys," says Brown. "Next seems likely to be that player."

But it isn't yet clear which company is best positioned to tackle the big commercial workstation market shares. IDC's Brown thinks the four heavyweights that now dominate the technical market—IBM, Sun, HP, and DEC—will also dominate the

By 1993, Sun Microsystems aims to divide its workstation sales evenly between technical and commercial users, says Sun's Gary Little

commercial side. "I'd say IBM will take the lead, followed by HP and Sun. DEC is still a big question mark," she says.

Of all of the workstation vendors, IBM is clearly the best-entrenched company for the nontechnical market, with inroads to virtually every vertical market and an unmatched sales and distribution network. But many observers think IBM isn't likely to aggressively market its RS-6000 workstation, since it already has undermined sales of IBM's AS/400 mini and even threatens to erode Big Blue's lucrative mainframe business.

Hewlett-Packard, IBM, and Sun now seem best positioned to take the lead in commercial markets

Nevertheless, IBM doesn't regard the RS-6000 as a liability to larger systems sales. Chris Walter, IBM's director of advanced workstations marketing in White Plains, N.Y., argues that many factors go into customers' buying decisions—including the decision to go with either distributed computers or mainframes. "The RS-6000 just adds to the range of products we offer," she says.

Sun, meanwhile, suffers from the lack of an entrenched commercial distribution network but is working hard to establish commercial channels. HP is considered second to IBM in terms of established commercial channels and will be a strong contender. DEC, the fourth technical-workstation market heavyweight, still seems stalled in its efforts to market commercial workstations.

Scarce software

Few other workstation vendors to date have sold large numbers of products into the commercial market, largely because the available applications software is relatively scarce and highly customized. Some vendors, such as Silicon Graphics Corp., are sticking to technical applications, with little apparent interest in the commercial sector. In any event, the commercial market is so large that very few broad-based standardized software packages will likely emerge within the next few years. "There's a lot of internal software development going on for these applications," says HP's Tolliver, "but eventually we expect to see some broadly based software packages."

In the meantime, he says, the trick for workstation vendors will be to package software and hardware as a solution, making it easier for software developers to create custom applications. Vendors say that independent software suppliers are trying to address the shortage of application software; for now, large customer accounts are taking it upon themselves to develop applications that enable them to use workstations. In most cases, they say, the final package is still cost-effective when compared with mini alternatives.

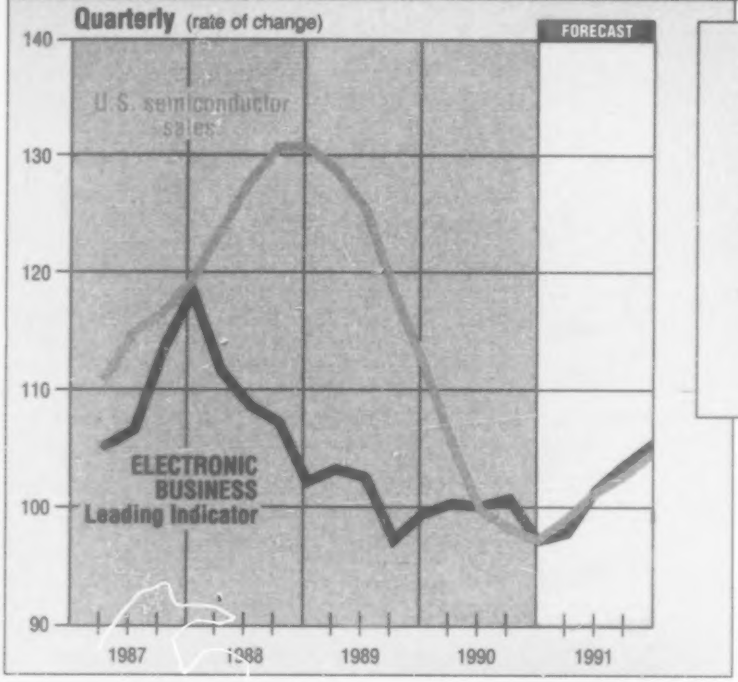
No one is sure just how fast the commercial workstation market will grow. But Sun's Little expects the commercial market for Unix-based systems (which includes both workstations and minis) to grow larger than the technical market by 1994. Little estimates the 1989 technical market at $6.5 billion, versus $5 billion for commercial applications. By 1994, he says, Sun expects the technical side of Unix to grow to $19 billion and the commercial side to $23 billion.

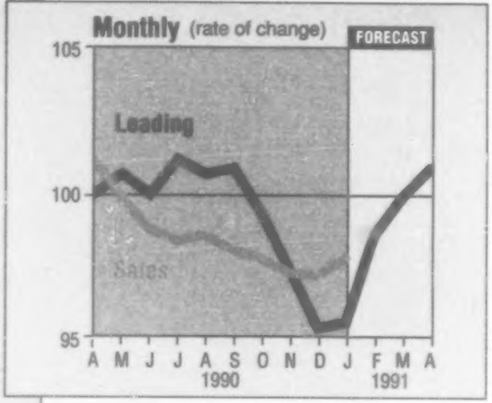
If he's right, it seems that there is plenty of room for growth for all the major players, and many of the minor ones as well. ☐

BUSINESS BAROMETER

FORECASTS FOR ELECTRONICS, COMPUTERS, AND SYSTEMS

ELECTRONIC BUSINESS Leading Indicator remains flat in January





Leading Indicator remains flat in January

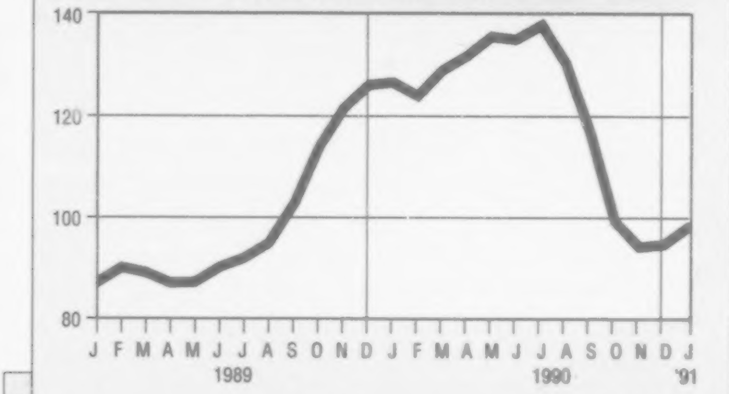
The worst may be behind us. The ELECTRONIC BUSINESS Leading Indicator appears to have bottomed out. Since the most recent peak of 101.3 in July 1990, the EBLI sank to 95.5 in December, which may prove to be the low point of the current business cycle. In January, it flattened out at 95.7, which is a positive signal.

Of the six components that make up the EBLI, three declined steadily this past autumn and contributed the most to the sagging EBLI. Stock prices had the largest swing, from a three-month rate of change of 137.6 in July 1990 to a low of 94.2 in November 1990. The next two months posted growth for stock prices—an optimistic sign for a recovering EBLI.

The ELECTRONIC BUSINESS Leading Indicator is a weighted composite of six statistics that tend to lead activity in the electronics industry. To obtain your complimentary background paper, contact Cahners Economics, 275 Washington St., Newton, MA 02158-1630, USA; telephone (617) 630-2119; fax (617) 630-2100.

Stock prices on the mend

Semiconductor composite stock price (Quarterly rate of change)



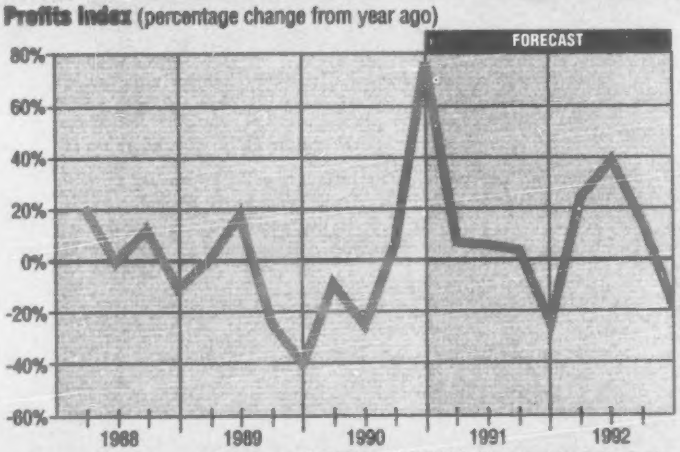
Source: Standard & Poor's

	Latest month	Previous month	Year ago	1990 average
ELECTRONIC BUSINESS Leading Indicator (rate of change, Jan.)	95.7	95.5	101.7	99.8
U.S. semiconductor bookings ($ millions, 3-month average, Jan.)	$1,107	$1,139	$1,233	$1,249
Weekly hours of semiconductor production workers (monthly average, Dec.)	41.1	40.8	41.7	40.4
Electronics components lead time index (1977 = 100, Feb.)	108.0	73.9	89.9	80.7
S&P's semiconductor stock price index (1970 =10, monthly average, Jan.)	59.6	57.4	60.5	64.6
Change in electronic components inventories ($ millions, SA, Dec.)	$30	$65	-$187	$33.9
Contracts and orders for plant and equipment ($ billions, SA, Dec.)	$44.9	$40.5	$48.9	$42.1

SA = seasonally adjusted; all other data are not seasonally adjusted

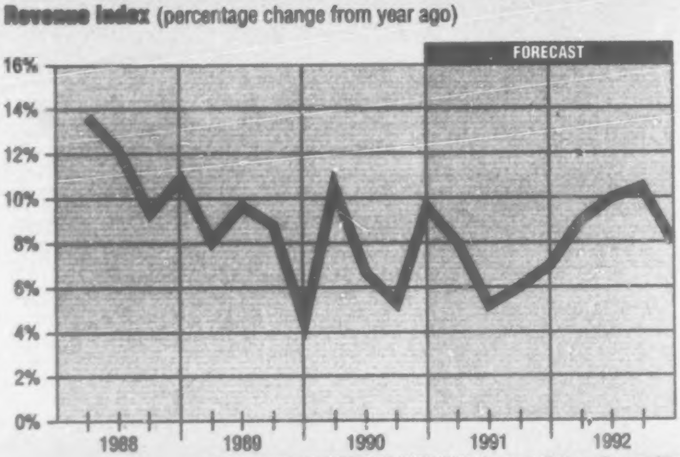
Sources: Semiconductor Industry Association, U.S. Bureau of Labor Statistics, *Electronics Purchasing*, Standard & Poor's, U.S. Department of Commerce , U.S. Bureau of Economic Analysis

Electronics profits surge in fourth quarter...



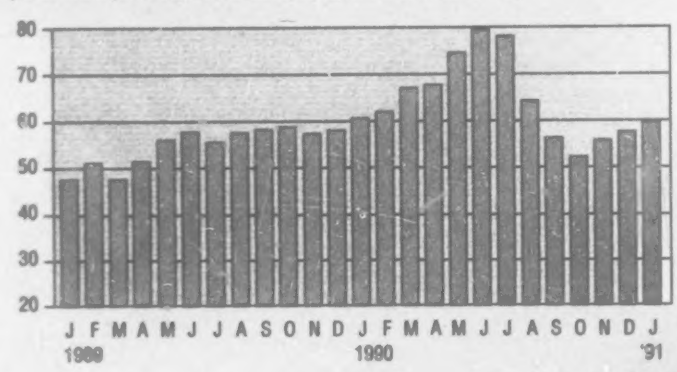
Data source: ELECTRONIC BUSINESS; Forecast: Cahners Economics

...while revenues continue to build...



Data source: ELECTRONIC BUSINESS; Forecast: Cahners Economics

...and investors are bidding up stock prices



Data source: Standard & Poor's

Despite gloom, profits grew in 1990

The electronics industry recorded one of its most profitable periods in the fourth quarter of 1990. According to the ELECTRONIC BUSINESS profits index—a sampling of the financial performances of 17 major electronics companies—profits surged 76.4% in the fourth quarter compared with a year earlier. Profits for the entire year rose 8.3% from 1989.

Why did electronics industry profits soar even though the economy was heading into a recession? One reason is that revenue growth remained steady in 1990. Receipts climbed 9.6% in the fourth quarter compared with a year ago and rose 8% in all four quarters of 1990 compared with 1989.

Secondly, restructuring in 1989 helped 1990 earnings. The electronics industry has been experiencing relatively slow growth since 1988; in response, many electronics companies restructured. These one-time charges were partly responsible for a 13.8% profits decline in 1989, but they also meant that the 1990 bottom line was bound to improve, recession or no recession.

Thirdly, a falling U.S. dollar boosted the bottom line of most of these U.S.-owned companies. According to Cahners's electronics trade-weighted dollar index, the dollar reached a new low in October 1990. That made U.S. electronics products less expensive abroad, and foreign sales expanded in response. Furthermore, those U.S. companies who have a high share of foreign sales saw their balance sheets improve as foreign sales made in local currency were translated back into U.S. dollars.

As a result of the stronger profits, investors are once again interested in electronics companies. Standard & Poor's stock price index for semiconductor and component companies climbed from a low of 52 in October to 59.6 in January. Wall Street analysts believe that higher profits are ahead for the electronics industry. As long as domestic demand flounders, however, Cahners Economics' profit outlook remains cautious. New orders for electronics are dragging at home. Unless the domestic market recovers quickly, profits will drop 5% in 1991. In contrast, 1992 should see profits rise 13%.

JOHN FARRELL

For more information on Cahners Economics' forecasting services, including seminars, newsletters, and database diskettes, contact Dan Buchan at (617) 630-2105, by fax at (617) 630-2100, or write Cahners Economics, 275 Washington St., Newton, MA 02158

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APRIL 22, 1991

HOW TERADATA KEEPS GROWING

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The 100 fastest-growing electronics companies

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Demand for quality fuels date-code debate

PAGE 49

Kenneth W. Simonds, CEO
Teradata Corp.

Teradata revenues:
1990
$224 million
1989
$137 million
1988
$89 million

Electronic Business

FOR MANAGEMENT IN ELECTRONICS, COMPUTER, AND SYSTEMS COMPANIES—WORLDWIDE

VOL. 17, NO. 8

APRIL 22, 1991

PAGE 30 **Teradata CEO Kenneth Simonds: "The challenge is to avoid getting too stodgy or bureaucratic"**

COVER STORY/STRATEGIES

30 Teradata's low-profile road to a high growth rate

Teradata's conservative, almost anonymous way of doing business contrasts starkly with the razzle-dazzle on display at most rapidly growing companies. But CEO Kenneth Simonds has taken the Los Angeles-based computer maker to the top spot in this year's list of ELECTRONIC BUSINESS's 100 fastest-growing companies

Cover photograph: Ed Glendinning

UPDATE

11 Business Trends

U.S. lags in "critical" technologies; debate continues over HDTV standard; interactive TV comes to the home; drop in electronics employment; IBM finally a player in the workstation market; RAIDing the disk-array market; Zilog goes public; Data General debuts new machines

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Fluent Machines Inc. brings videoconferencing to desktop computers; Cellular Data Inc. transmits data over unused airwaves; Chronology Corp. produces timing diagrams

27 Commentary

Intel's 486 is on a roll, but Will Fastie wonders who really needs all that power

COVER STORY/STRATEGIES

30 Teradata's low-profile road to a high growth rate

It seems that there's no holding back computer maker Teradata. With 1990 sales of $224 million, the Los Angeles-based company has been sizzling along at a compounded average annual growth rate of 140%, landing at the top of ELECTRONIC BUSINESS's list of the 100 fastest-growing electronics companies. What remains to be seen is how Teradata will ride out a recession at home and abroad in addition to the weakness in several of its key domestic markets

34 Meet the runners-up

With compounded average annual growth rates topping 100%, five electronics companies—Sequent Computer Systems, Oracle, Komag, Dallas Semiconductor, and Octel Communications—dominate this year's list of fastest-growing companies

COVER STORY/STRATEGIES

38 Top 100 fastest-growing U.S. electronics companies

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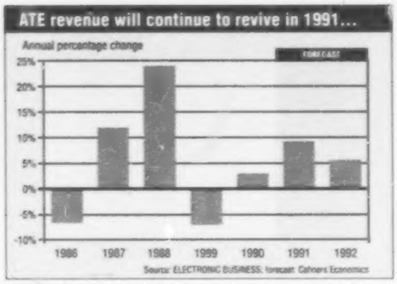

ATE revenue will continue to revive in 1991...

Source: ELECTRONIC BUSINESS; forecast: Cahners Economics

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INSIDE BUSINESS

What's in a name?

Funny how certain brand names become burned into the public consciousness over the years. When I was a kid, the rites of passage for any young male included a '55 Ford, ideally in pink and black. Chocolate was spelled H-E-R-S-H-E-Y. You kept your milk and eggs in the "Frigidaire," no matter who made it.

Tom McHale, executive editor of *Electronic Business Asia*

Today, the need for brand-name recognition has dawned on the South Korean electronics industry. As in Japan, Korean producers broke into electronics as suppliers of low-cost (and often low-quality) consumer products, which were then distributed under the logos of better-known manufacturers. By one estimate, these OEM sales now account for 70% to 80% of Korea's total electronics exports.

But in another analogy with Japan, Korea now feels compelled to start recouping its skyrocketing R&D and labor costs through higher value-added products, while at the same time earning some much-needed recognition. As Geoff Crane reports in this issue, Goldstar, Daewoo Electronics, and other Korean giants hope to meet those goals and cut their heavy dependence on OEM sales by pushing products under their own names. Their success, says Crane, will depend largely upon whether Korean designers can take yet another tip from Japan—this time by adding that special look and touch that magically sets one product apart from all the others on the shelf.

Crane's story also appeared in our sister publication, *Electronic Business Asia*, which celebrates its first anniversary next month. The Hong Kong-based magazine is Cahners Publishing's first foray into the Asian market, and in a sense it provides another lesson in creating name recognition in a key market.

What prompted Cahners to launch *Electronic Business Asia*? The reason, explains executive editor Tom McHale, is that Asia will represent the world's largest electronics market by the year 2000—$339 billion, compared with $325 billion for North America and $292 billion for Europe. No company can afford to ignore those numbers, says McHale. That's why *Electronic Business Asia* is not just an "Asian version" of a U.S. magazine: The magazine is written by its own staff of writers and correspondents throughout Asia and is pegged exclusively to 40,000 executives in Japan, Taiwan, Korea, and every other major Asian market.

Admittedly, *Electronic Business Asia* is not yet a Ford or a Hershey in terms of worldwide name recognition; that will take time, and a lot of grunt work by McHale and his staff. Meanwhile, we at ELECTRONIC BUSINESS are gratified that we can offer our readers this unique window on Asia, which is unmatched by any other U.S. electronics magazine.

H. GARRETT DeYOUNG, managing editor

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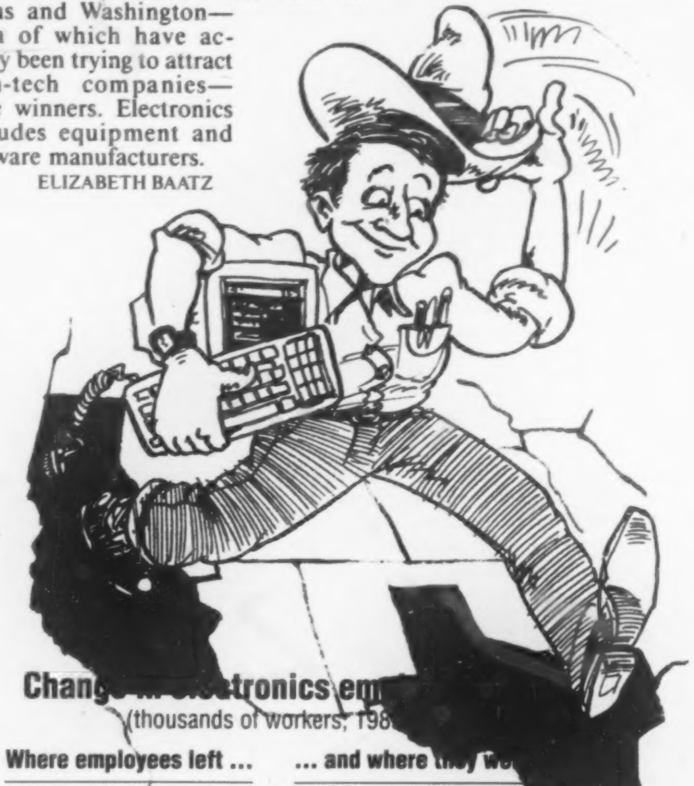
BPA ABP

EMPLOYMENT

Electronics employment figures drop

TOTAL U.S. ELECTRONICS employment in 1989 was 2.58 million workers, 20,000 fewer workers than 1988. But even though overall employment was down, states such as Texas and Washington—both of which have actively been trying to attract high-tech companies—were winners. Electronics includes equipment and software manufacturers.

ELIZABETH BAATZ



Chang[illegible]tronics em[illegible]
(thousands of workers, 198[illegible]

Where employees left ...		... and where [illegible]	
California	-19	Texas	+6
Massachusetts	-13	Washington	+4
New York	-6	Tennessee	+3
Pennsylvania	-6	North Carolina	+3
Arizona	-5	Colorado	+3
Connecticut	-4	Michigan	+3
New Jersey	-3	Mississippi	+3
Utah	-3	Oregon	+3

Source: American Electronics Association

loophole has allowed such satellites as Astra, owned by the Luxembourg-based Societe Europeene des Satellites (SES), to circumvent the ruling by transmitting on the PAL system, Europe's most popular broadcast standard.

The Astra-supplied programs were an almost immediate success. While only 100,000 European TV viewers receive MAC programs via Direct Broadcast System satellites, about 2.5 million receive PAL programs directly from such medium-powered satellites as Astra, according to Astra marketing director Koen Van Driel. He predicts that by the end of the decade, the relatively cheap 60-cm satellite dish required for Astra reception will be installed in 77 million residences—66% of all European homes.

"You can't impose choices on the consumer," asserts Pierre Meyrat, SES's managing director. He fears tighter MAC restrictions would put the fledgling company out of business and warns of the potential damage in developing a competitive pan-European audiovisual market if MAC is imposed. The pro-MAC faction risks seeing billions of investment dollars wasted if the single MAC standard is scrapped.

LINDA BERNIER

CONSUMER ELECTRONICS

Home shoppers rejoice: Here's interactive TV

IF YOU THOUGHT technology had reached its capacity for squelching human get-up-and-go in the name of convenience, think again. When interactive television ("interactive video service" in Federal Communications Commission parlance) hits the airwaves later this year, couch potatoes won't even have to dial that 800 number to do their home shopping.

On Jan. 10, the FCC issued a notice of proposed rule making—generally a sure sign of acceptance once the requisite comment periods and technical tinkering have taken place—to allocate half a megahertz of broadcast spectrum space to such services. That is roughly the equivalent of one-sixth of a broadcast television channel.

The service under consideration will allow viewers to bring up an order form during an advertisement with just the click of a remote control. TV Answer Inc. of Reston, Va., the developer and prime lobbyist for the technology, reports enthusiasm from advertisers, who love the immediate, computer-to-computer transaction processing. Broadcasters also have a stake, as the service could put the reins on channel-hopping during ads.

There are non-commercial uses as well. Colleges will be able to offer televised courses complete with exams, news organizations will be able to poll hundreds of thousands of people in virtual real time without having to bother them on the phone, and—maybe best yet—VCR manufacturers will be able to offer on-screen fill-in-the-blank programming for those millions who still haven't figured out their instruction manuals.

But TV Answer probably loves it the most. The company has spent $20 million and 10 years developing the basic technology under consideration, which is actually more like cellular telephone than television. In the system, transmission stations located in cells throughout the nation—each serving about 10,000 households—receive information to be broadcast from company headquarters via satellite. The programming is then converted into radio signals and transmitted to VCR-like computers that sit atop subscribers' TV sets. Although the FCC has spurned TV Answer's bid for a nationwide license (they propose a local bidding process in which available spectrum is divided to enable competition in every cell), the company expects to be installed in 62 million homes by the year 2000.

PETER BURROWS

WORKSTATIONS

IBM: no longer the workstation weakling

IBM IS NOT getting too cocky about the success of its RISC System/6000 workstation—at least not yet.

Despite the phenomenal success of the RS/6000 line since its February 1990 introduction and IBM's aggressive goals for workstation market share, company executives are cautioning analysts against overly optimistic predictions for RS/6000 sales this year. IBM pushed a lot of the workstations out the door in late 1990—10,000 units in December alone—in order to meet pent-up demand. But while some industry watchers have extrapolated that sales rate into 1991, IBM is more cautious.

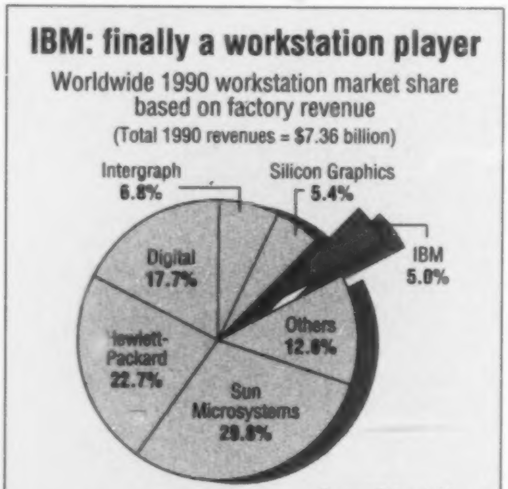
"I think some of the projections extending [the late 1990 sales] out into the $2 billion to $3 billion range for 1991 are a bit too aggressive," said Bill Filip, IBM vice president and president of the Advanced Workstations Division, during the March introduction of additions to the RS/6000 line. IBM is hinting at 1991 sales figures in the range of $1.7 billion to $2 billion.

Nevertheless, after years of failure with the feeble RT, the RS/6000's predecessor, IBM is not above trumpeting its success. Filip claimed that IBM sold 25,000 RS/6000 workstations and servers last year, generating $1 billion in sales. (Because that includes software, peripherals, and other products, plus RS/6000 systems used as midrange multiuser computers, Dataquest puts IBM's workstation sales at $366 million for a 5% share of the $7.35 billion 1990 worldwide workstation market.) This year IBM is aiming for double-digit market share, according to Filip, and has its sights on becoming the leading workstation vendor by 1993.

Last month the company unveiled the 320H PowerStation addition to the RS/6000 line, boasting a 25-megahertz RISC chip that offers 11.7 MFLOPS (millions of floating point operations per second) of speed. Also introduced was a high-end server system and options to improve RS/6000 storage capability and graphics performance. Filip hinted that a low-end addition to the RS/6000 family will be released later this year.

There also are signs that IBM is becoming more price competitive. A price list in the 320H PowerStation press kit put the cost of a sample configuration of the workstation at $20,501. A last-minute handout at the press conference listed the same configuration at $17,972. Journalists were told to ignore the old release.

RICK WHITING


IBM: finally a workstation player

Worldwide 1990 workstation market share based on factory revenue

(Total 1990 revenues = $7.36 billion)

Source: Dataquest Inc.

DISK ARRAYS

RAIDing the market with an old idea

FOR YEARS, disk-drive vendors have been trying to pry open a market for disk-array systems, and it appears that with help from systems vendors, the market now may indeed be opening up.

Disk arrays are storage subsystems composed of a handful of small form factor disk drives. They are strung together with the intent of improving not only capacity and performance, but integrity of the data through fault-tolerant storage techniques. There are five levels of array capability measured by so-called RAID standards—literally, a redundant array of inexpensive disks. Arrays at the RAID-3 level boost data integrity through mirroring data across the array, or having more than one disk with the same data in the event a drive breaks. RAID-5 drives improve performance and integrity through data striping.

Compaq Computer Corp. gave a booster of legitimacy to the disk-array market last year upon introducing a RAID-5 array option with its SystemPro line. At the Comdex trade show in November, Micropolis Corp., one of the first disk-drive vendors to push an array (it had a meager marketing effort in the early 1980s), also introduced a modular software-based RAID-5 array of five 5.25-inch drives. More recently, Data General offered a disk-array option with its new Aviion Unix servers (see related story).

At about the same time, Comdex, NCR Corp., and Seagate Technology Inc. announced a joint development of a RAID-5 subsystem, and NCR is now on the march to market array controllers and subsystems to a number of major system OEMs. NCR is already shipping a five-disk array of 200 megabyte Seagate drives that it says is in hot demand by database and on-line transaction processing customers who can't afford mainframe DASD-type storage. Storage Technology Corp. also has an array program and IBM has been shipping RAID arrays as an option with its systems. A 2-gigabyte RAID-5 disk array can cost as little as $1,500, compared with an 8-inch form factor

Teradata's low-profile road to a high growth rate

Conservative yet entrepreneurial, the computer maker tops ELECTRONIC BUSINESS*'s list of the 100 fastest-growing U.S. electronics companies*

BY RICK WHITING

Financial analysis for this year's report was provided by senior editors Elizabeth Baatz and Linda Stallmann. The five runner-up companies (each with a five-year compounded average annual growth rate of 100% or more) are profiled by associate editor Dave Webb.

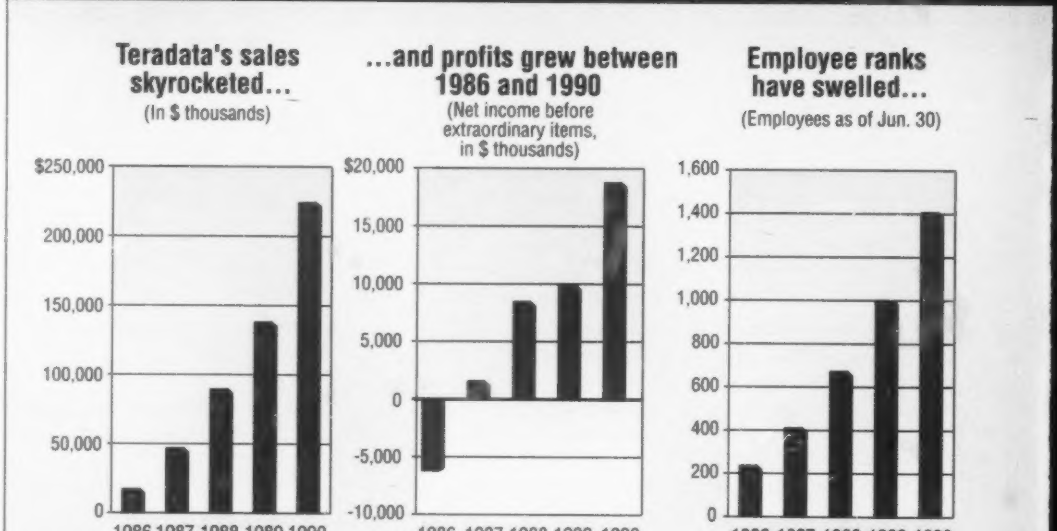
If you spend much time studying fast-growing technology companies, you'll quickly conclude that many of the companies become as famous for their glitz, cockiness, and brash management styles as for their bottom-line performance. In workstations, for example, Sun Microsystems' Scott McNealy comes almost immediately to mind; in the chip world, it has to be Cypress Semiconductor's T. J. Rodgers.

Then there's Teradata Corp. Until recently, the Los Angeles-based company was almost as faceless as its products—powerful but unglamorous computers that generally chug quietly away in a back room, virtually out of sight and out of mind. At one time, some outsiders even thought that Teradata was in the earth-moving business because of its ambiguous name. (The name actually comes from the computers' ability to store and manipulate trillions of bytes—"terabytes"—of data.)

But Teradata has shucked its obscurity once and for all. The company was named *Inc.* magazine's fastest-growing small public company in 1989 and has achieved a compounded average annual growth rate (CAAGR) of 140% in the last five years. Sales last year hit $224.2 million. That puts Teradata at the top of ELECTRONIC BUSINESS's list of the 100 fastest-growing U.S. electronics companies, joining an exclusive club of companies with five-year CAAGRs of more than 100%.

Teradata's low profile still sets it well apart from Sun Microsystems and Cypress Semiconductor, which copped the ELECTRONIC BUSINESS award in 1989 and 1990, respectively. Despite a customer list made up almost exclusively of *Fortune* 200 companies, Teradata's success has come without the razzle-dazzle typical of so many fast-growing companies. Rather, Teradata executives and customers, as well as industry analysts, claim that the company has done so well because it has the right product for the right market: parallel-processing computers that sort and

Teradata's quiet climb to the top



Teradata's sales skyrocketed... (In $ thousands)

...and profits grew between 1986 and 1990 (Net income before extraordinary items, in $ thousands)

Employee ranks have swelled... (Employees as of Jun. 30)

Source: Company Reports

compile blocks of information that are too voluminous even for mainframes from IBM and other vendors.

The TransAmerica Insurance Group, for example, relies on its Teradata system to process massive volumes of information about insurance accounts and claims histories and to track the performance of its 5,000 agents. K Mart Corp. improved its Christmas shopping season profits last year when its Teradata computer, sorting through sales and inventory data, picked hot-selling items in time for store managers to reorder. Consumer products companies such as Helene Curtis Industries Inc. and Procter & Gamble Co. also use Teradata computers to monitor sales and inventories. And as these and other corporations increasingly rely on computers to store large amounts of data, it seems certain that Teradata's market will also increase.

Still, all is not roses for Teradata. The company's rapid expansion was interrupted during its first fiscal 1991 quarter last fall because of weakness in several key markets. With an average price tag of $1.3 million, Teradata computers are big-ticket purchases that customers may opt to delay in the midst of a recession, notes Kenneth W. Simonds, chairman, chief executive, and president. The company also has just introduced its DBC/1012 Model 4, based on Intel Corp.'s 80486 chip, and product transitions are always dicey for fast-growing companies.

Founded by employees of Citicorp subsidiary Transaction Technology Inc. and Xerox Corp., Teradata was slow getting out of the gate. The company's first product, the 8086 chip-based DBC/1012 Model 1, wasn't shipped until 1984 and proved to be underpowered for its assigned tasks. And because parallel-processing and relational database computing were new concepts at the time, market acceptance for Teradata's products was slow in coming. Sales began to pick up in 1985 and accelerated in 1986 with the introduction of the company's second-generation product, the 80286-based DBC/1012 Model 2.

Today, the capabilities of the company's computers allow Teradata to occupy a niche all by itself. "You've got to start with the product. That's clearly the cornerstone," says Donald C. Cantor, chief operating officer and executive vice president of operations. True, Tandem Computers Inc. and Sequent Computer Systems Inc. are boosting the power and database capacity of their computers to make a run at Teradata's market, and IBM mainframes are an alternative for prospective Teradata customers. But for the moment, at least, Teradata's claims of having no real competition is more reality than marketing hype.

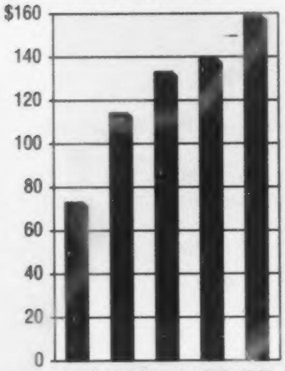
But Teradata managers claim that there's more to the company than simply good technology—there's also what Simonds calls an entrepreneurial environment and a willingness to take risks, but without the "free-wheeling" attitude of so many other companies with stratospheric growth rates. "The challenge," he says, "is to avoid getting too stodgy or bureaucratic."

Teradata maintains its startup spirit by organizing itself into small entrepreneurial business units, each

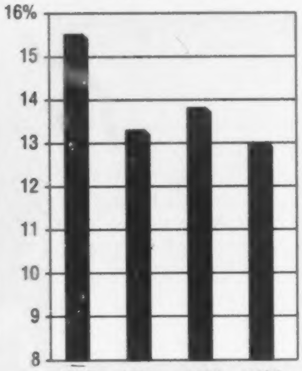
Teradata CEO Kenneth Simonds: "The challenge is to avoid getting too stodgy or bureaucratic"

Ed Glendinning

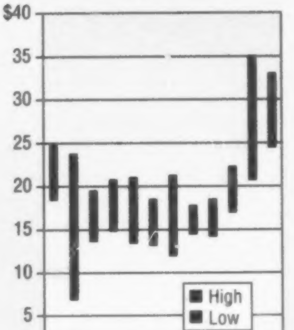
...while revenue per year-end employee has grown...
(in $ thousands)



...and R&D expenditures have held steady
(R & D expenses as a percentage of sales)



Stock prices* have been mixed
(High and low stock prices during fiscal year)



* company went public in Aug. 1987

Teradata at a glance

Annual data	1990	1989
Sales (thousands)	$224,206	$137,411
Net income (thousands)	$18,758	$9,904
Net income/ sales	8.4%	7.2%
Cost of sales/sales	38.6%	36.9%
R&D/sales	13.0%	13.8%
Marketing, G&A/sales	32.5%	35.9%
Number of employees	1,406	1,001
Sales per employee	$159,464	$137,274
Net income per employee	$13,341	$9,894
Capital expenditures/sales	15.3%	14.1%
Current ratio	2.70	2.60
Debt/equity ratio	0.15	0.16
Foreign sales/sales	24.4%	29.2%

All figures for fiscal year ended June 30

Quarterly data	1990	1989
Sales (thousands)	$111,220	$97,586
Net income (thousands)	$ (7,175)	$6,460

Information for 6 months ended December 31

Source: Company reports

focusing on such specific areas as Unix development, professional services, and networking products. The company also operates the Teradata Advanced Concepts Laboratory, which develops prototype products using leading-edge technology, and provides an avenue for employees to introduce ideas for new products or technologies.

Teradata's culture of entrepreneurship and customer focus is instilled into new employees through education and training, "weaving them into the fabric of the company," as Simonds describes it. Most Teradata workers have a stake in the company's growth: A full 80% are also stockholders.

Management-employee communications play a critical role in empowering employees to help define the company's direction. Each month the CEO and COO meet separately with workers, chosen at random from various departments, to make company announcements and take questions. The routine is repeated at quarterly companywide "roundup" meetings.

Keeping up with the company's fast-moving infrastructure hasn't been easy. Last year Teradata moved from the Marina del Rey section of Los Angeles into a high-rise in El Segundo, just south of Los Angeles International Airport. A new manufacturing facility in Dublin, Ireland, now augments the company's Los Angeles plant. To keep up with the company's accounting and billing operations, senior vice president of finance and administration Michael F. G. Ashby is in the process of overhauling Teradata's financial data-processing system—which includes three Teradata computers.

Keeping the spirit

But the biggest challenge for the company's managers is to maintain Teradata's explosive growth rate while keeping its entrepreneurial culture intact. Simonds's ambitious goal is to reach $1 billion a year in the mid-1990s and possibly $3 billion by the year 2000. Employment, which stood at 130 five years ago, now stands at 1,500, with about 100 employees being added each quarter.

Teradata's management team is a mix of the old and the new, although many of the top positions are held by people who came aboard after the company was established. Simonds, for example, joined Teradata in 1984, Cantor in 1986. Co-founder Jack E. Shemer remains as vice chairman while Jerold R. Modes, who also helped found the company, serves as senior vice president of strategic business operations. Co-founder Philip Neches left in 1988 to become senior vice president and chief scientific officer at NCR Corp.

Simonds came to Teradata after a 10-year stint at Amdahl Corp. where he was executive vice president. An amiable, self-assured Tennessean whose office is decorated with black-and-white nature photos by Ansel Adams, he also had spent 18 years at IBM in a variety of sales, sales management, and technical management posts. He joined Teradata as president and chief operating officer under Shemer and then shared the office of chief executive for just over a year before becoming CEO in December 1986.

"My experience at Amdahl was invaluable," he says, noting that he joined the mainframe vendor at approximately the same stage of growth as Teradata was when he joined it. And because many of Teradata's customers are also IBM accounts, Simonds's years with Big Blue are proving equally valuable.

Cantor joined Teradata as vice president of U.S. field operations and worked his way up through senior and executive vice president. Along the way he assumed responsibility for sales, marketing, customer service, manufacturing, corporate administration, and R&D. He was appointed chief operating officer last August.

Although his education is in technical engineering, Cantor's resume is similar to Simonds's—six years at IBM, "which gave me a good feel for the customer," he says, and eight years with Amdahl, "which gave me a good perspective on how to compete with IBM." He adds that two years at software start-up Intellistor Corp. "provided experience in everything from opening new markets in Europe to unstopping toilets."

Back on track

It was probably inevitable that the recession and the U.S. banking crisis would eventually show up on Teradata's doorstep. Slow sales in the U.K. (which accounts for 60% of the company's European sales) and decreased orders from the U.S. banking industry dragged down the first quarter's performance. Sales for the period were $47.4 million—up only slightly from $42.9 million a year earlier—and the company reported a net loss of $7.6 million. As a result, Teradata's stock price over the last 12 months has oscillated between $35.50 and $6.75. (The company went public in August 1987 at $20.)

Management acted quickly to maintain Teradata's profitability, reducing expenses and cutting about 200 workers from the payroll. Sales rebounded in the second quarter (ended Dec. 31) to $63.8 million, up from $54.6 million in the same period one year ago, and the company turned a $436,000 profit. The second-quarter results included $9.5 million in revenue from ShareBase

Corp., which Teradata acquired in June 1990.

Teradata watchers say the company is back on track, but that management must keep expenses from outpacing sales. Cantor says the company has resumed hiring, for example, but more selectively.

With perhaps a hint of relief, Teradata's executives now project that the company's annual growth rate will slow to 20% to 40% in the next two to three years. That somewhat more manageable pace should help Teradata pull off what Simonds describes as the company's most pressing task: to maintain the start-up spirit that has allowed Teradata to quietly, all but anonymously, carve out its own unique niche. ☐

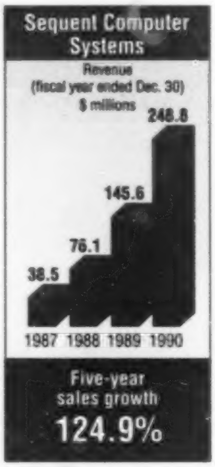
Meet the runners-up

Sequent Computer Systems Inc.

Beaverton, Ore.

2

For a company looking to butt heads with the likes of IBM in the mainframe world by relying on machines built with standard PC microprocessors, Sequent has done remarkably well. The maker of so-called symmetric multiprocessing computers—boxes with up to 30 Intel 80x86 microprocessors—has grown from a start-up in 1983 to a $250 million company, for a compounded average annual growth rate (CAAGR) of 125%. Profits for the latest fiscal year (ended Dec. 29) came in at $18.8 million.



The strategy is a simple one: Use cheap, standardized chips to build relatively inexpensive but powerful systems that will run many standard software programs. Focused primarily on the on-line transaction-processing (OLTP) market, Sequent touts its systems as low-cost, nonproprietary mainframes. The goal, according to a company source, is "to build a company that would lead a fundamental change in the way computers are built and used."

Sequent recently introduced its latest systems, based on Intel's 80486 chips, which can handle more than 1,000 users at the top end of the product line. The computers range from $23,500 to $2.5 million, and 80% of them are targeted to commercial applications (largely OLTP), despite their roots in technical and design research markets.

Using a multitiered distribution policy, Sequent makes 65% of its sales directly to customers but also maintains OEM agreements with Unisys Corp., Siemens A.G., and MAI Systems.

While corporate buyers seeking cheaper alternatives to proprietary mainframes have boosted Sequent's business, the company stands to be hurt by the continued erosion of the mainframe market—namely, the cheaper, more powerful microprocessors that run systems and applications software with mainframe-like performance. Despite its impressive long-term growth, Sequent sources are cautious about the first quarter of 1991 because of the expected slowdown in OEM sales; as a result, the company's earnings and revenue for the quarter ending in March probably will be lower than expected. ☐

Oracle Corp.

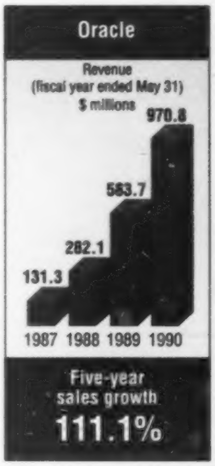
Redwood Shores, Calif.

3

Not too long ago, Oracle Corp.'s cocky CEO Larry Ellison was trumpeting the database company that knew all, saw all, and would overrun all in its software market. For awhile, it seemed that he was right: As of last year, Oracle was running at a CAAGR of 111%.

By late 1990, however, Ellison found that his company had lost some of its magic, and he, himself, had become an object of wrath. Investors, competitors, and customers heaped scorn on the erstwhile high-flyer, which grew to nearly $1 billion last year then took a loss of $36 million in the first quarter of 1990.

Since then, Oracle is delivering on its promises to revamp the once out-of-control management and clamp down on operating costs and overhead that accounted for much of the company's financial headaches. In its second fiscal quarter (ended Nov. 30), the company posted a net profit of $6.7 million on sales of $167 million.



The company is still a major force in the relational database market with its SQL (Structured Query Language) DBMS software and database servers for mainframe, minicomputer, and distributed PC/workstation network environments. But its strategy puts it head-to-head with Digital Equipment Corp. and IBM, as well as pitting it against independents such as Ashton-Tate, which (like Oracle) serves a spectrum of hardware environments. ☐

Komag Inc.

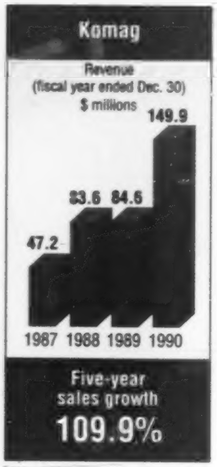
Milpitas, Calif.

4

Komag president and CEO Stephen Johnson has a term for competitive innovation. He calls it "chasing the rabbit." The "dogs" in the analogy are his company and his competitors; "the rabbit," the goal of providing top-quality, highest-performance disk-media products at a competitive price—while still bringing in respectable profits.

More than 90% of Komag's business is directed at the high-performance disk-drive market. The company makes sputtered thin-film media instead of oxide media, which is widely used in low-end, older-technology disk drives. Komag competes with Akashic Memories Corp., Nashua Corp., Xidex Corp., and Stolle Corp., among others. The company also supplies OEM drive vendors such as IBM, Seagate Technology, and Hewlett-Packard Co., which also make media but need an outside source to supplement their own production or to make a specific class of drive for which their own media do not qualify.

Cruising along at a CAAGR of 109%, Komag is riding the latest wave in the PC market. Conner Peripherals and other producers provide the disks for low-power 3.5- and 2.5-inch disk drives for notebook-size and laptop computers. The company reported sales of $150 million for its fiscal year 1990 (ended Dec. 31), up 77% from the previous year. Profits that year hit $13.4 million, an abrupt turnaround from the $6.1 million loss during fiscal 1989. The loss stemmed from a drive industry malaise arising from severe price-cutting and glutted inventories, a situation which eventually wiped out a slew of disk and component vendors (including Domain Technology Inc., Komag's biggest U.S. competitor).


Komag

Revenue (fiscal year ended Dec. 30) $ millions

Five-year sales growth

109.9%

In 1987, when the company raised $34 million in its IPO, Komag reported a net income of $8.4 million on sales of $47.2 million.

As of last Dec. 31, Komag had $45 million in cash and $82 million in current assets. The company reports nearly $20 million in long-term debt and $23.9 million in current liabilities.

Komag expects to continue capitalizing on its small-diameter disk business and reportedly is considering buying a thin-film disk-drive head manufacturing operation to expand further into the drive component market. ☐

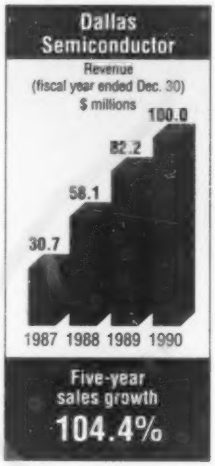
Dallas Semiconductor Corp.

Dallas, Tex.

5

When things turned sour for the U.S. semiconductor industry in the mid-1980s, many U.S. vendors found havens in the high-end markets for fast microprocessors, memory chips, and controllers. Those who stayed in the mainstream chip markets found it a tough swim upstream in the wake of Japanese vendors who had beat the standardized memory chip market.

Still, growing a company in such niche havens is tough too, yet Dallas Semiconductor managed it. The company, which posted $100 million in revenue for fiscal 1990 (ended Dec. 30), has capitalized on demand for ASIC chips in a wide gamut of applications. The 1984 start-up has built more than 100 base products that can be customized to specific applications by proprietary technology methods.


Dallas Semiconductor

Revenue (fiscal year ended Dec. 30) $ millions

Five-year sales growth

104.4%

Dallas Semiconductor's strategy does confine it to a small field of proprietary solutions vendors—not an entirely sound strategy when the computer industry is stumbling over itself to standardize just about everything in response to customer demand for greater interoperability. Nevertheless, the company grew to $30 million in 1987, the year of its IPO, to $100 million today—a CAAGR of 104%. In its fourth quarter ended Dec. 30, 1990, the company drew net sales of $25.7 million with a $3.6 million profit. For fiscal 1990, the company reported a $13.8 million profit.

Dallas Semiconductor's products include microprocessor chips that perform teleservicing or equipment-monitoring chips that perform diagnostics and adjustments to vending machines, instruments, and industrial equipment. The company also makes custom DRAMs, SRAMs, microcontrollers, digital signal-processing telecommunications chips, and battery backup devices. Despite what chairman and CEO C. V. Prothro calls "a generally lackluster industry performance last year," the company expects continued growth in application-specific markets. ☐

Octel Communications Corp.

Milpitas, Calif.

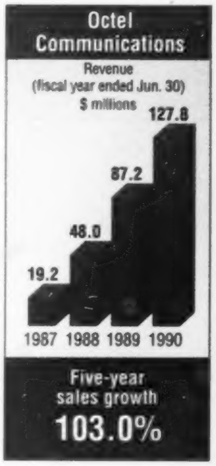
6

Every now and then a new technology comes along that promises huge market potential. Octel Communications chairman and co-founder Robert Cohn may have foreseen that kind of opportunity for voice-processing systems when the company was formed in 1982, but it isn't likely he foresaw Octel's growth to a $130 million company since then—a CAAGR of 103%.

For its fiscal year ended Jun. 30, 1990, Octel posted $128 million in revenue and a $27.2 million net profit. In the first six months of its fiscal 1991, the company reported combined quarterly totals of $72.7 million in revenue and $10.6 million in net profits. Octel went public in February 1988 and has been profitable since the first fiscal quarter of 1987.

Octel's competitors are Rolm, AT&T, Northern Telecom, and VMX in the large corporation/Regional Bell operating company target market. Competition in the contract voice-mail market includes Boston Technology and Digital Sound.

Despite a generally bright outlook, Cohn expects the company to feel the effects of the recession. The reason: Much of their growth comes from sales to contract voice-mail houses, which are prone to pullbacks in tough times. ☐


Octel Communications

Revenue (fiscal year ended Jun. 30) $ millions

Five-year sales growth

103.0%

continued

FASTEST GROWING COMPANIES 100

Electronic Business

Fastest-growing companies

1990 rank	1989 rank	Company	Five-year sales growth* (%)	Fiscal 1990 sales ($ millions)	Fiscal 1990 profits ($ millions)	Fiscal year ended	Industry segment
1	--	**Teradata** Los Angeles	139.8%	$224.2	$18.8	6/90	computers
2	--	**Sequent** Beaverton, Ore.	124.9	248.8	18.8	12/90	computers
3	3	**Oracle** Redwood Shores, Calif.	111.1	970.8	117.4	5/90	software
4	--	**Komag** Milpitas, Calif.	109.9	149.9	13.4	12/90	peripherals
5	--	**Dallas Semiconductor** Dallas	104.4	100.0	13.8	12/90	semiconductors
6	--	**Octel** Milpitas, Calif.	103.0	127.8	17.7	6/90	communications
7	--	**Everex** Fremont, Calif.	87.6	436.5	24.5	7/90	computers
8	4	**Sun Microsystems** Mountain View, Calif.	84.5	2,466.2	111.2	6/90	computers
9	2	**Silicon Graphics** Mountain View, Calif.	81.1	419.8	32.3	6/90	computers
10	38	**Symbol Technologies** Bohemia, N.Y.	75.4	231.5	7.6	12/90	computer-based systems
11	--	**Dell Computer** Austin, Tex.	74.6	546.0	27.2	1/91	computers
12	--	**Convex** Richardson, Tex.	73.0	209.3	18.4	12/90	computers
13	5	**Cadence** San Jose	70.4	231.4	38.0	12/90	software
14	1	**Cypress** San Jose	66.9	225.2	33.2	12/90	semiconductors
15	35	**Seagate** Scotts Valley, Calif.	62.2	2,413.2	117.2	6/90	peripherals
16	--	**Interleaf** Cambridge, Mass.	60.5	88.8	(16.0)	3/90	software
17	--	**BMC Software** Sugar Land, Tex.	58.3	93.0	20.3	3/90	software
18	--	**Borland** Scotts Valley, Calif.	57.8	113.3	11.8	3/90	software
19	--	**FileNet** Costa Mesa, Calif.	56.9	102.9	3.8	12/90	computer-based systems
20	7	**Maxtor** San Jose	56.7	491.1	18.9	3/90	peripherals
21	6	**Novell** Provo, Utah	55.2	497.5	94.3	10/90	software
22	16	**Microsoft** Redmond, Wash.	53.2	1,183.4	279.2	6/90	software
23	13	**Vishay** Malvern, Pa.	51.1	445.6	23.2	12/90	components
24	--	**Informix** Menlo Park, Calif.	50.6	146.1	(23.1)	12/90	software
25	--	**Concurrent** Tinton Falls, N.J.	49.7	340.1	(41.7)	6/90	computers
26	12	**Compaq** Houston	48.2	3,598.8	454.9	12/90	computers
27	8	**3Com** Santa Clara, Calif.	47.7	419.1	20.5	5/90	communications
28	19	**Rexon** Manhattan Beach, Calif.	46.3	158.2	8.5	9/90	peripherals
29	--	**Adaptec** Milpitas, Calif.	43.1	109.3	13.2	3/90	peripherals
30	23	**Computer Associates** Garden City, N.Y.	41.6	1,296.0	157.8	3/90	software
31	15	**Western Digital** Irvine, Calif.	41.4	1,070.5	24.2	6/90	semiconductors
32	10	**Integrated Device** Santa Clara, Calif.	40.4	209.5	17.0	3/90	semiconductors
33	14	**Pyramid Technology** Mountain View, Calif.	39.6	179.7	16.8	9/90	computers
34	21	**EMC** Hopkinton, Mass.	38.7	171.2	8.9	12/90	peripherals
35	29	**Archive** Costa Mesa, Calif.	38.4	293.2	11.5	9/90	peripherals
36	11	**Tandon** Chatsworth, Calif.	38.2	421.8	25.6	12/90	computers
37	17	**Stratus** Marlborough, Mass.	38.2	403.9	37.0	12/90	computers
38	32	**Silicon Valley Group** San Jose	38.0	184.3	4.4	9/90	semiconductor equipment
39	24	**LSI Logic** Milpitas, Calif.	36.2	655.5	(34.0)	12/90	semiconductors
40	--	**Applied Biosystems** Foster City, Calif.	34.9	158.9	6.1	6/90	medical equipment
41	27	**Micron Technology** Boise, Idaho	34.4	333.3	4.9	8/90	semiconductors
42	26	**QMS** Mobile, Ala.	33.0	276.3	14.6	9/90	peripherals
43	34	**VLSI Technology** San Jose	32.8	324.8	(12.7)	12/90	semiconductors
44	28	**Micropolis** Chatsworth, Calif.	32.0	380.6	7.9	12/90	peripherals
45	47	**Anthem Electronics** San Jose	31.4	408.2	23.2	12/90	distribution
46	30	**Intermec** Lynnwood, Wash.	31.2	168.5	11.5	3/90	computer-based systems
47	20	**AST Research** Irvine, Calif.	31.0	533.8	35.1	6/90	computers
48	51	**Data Switch** Shelton, Conn.	30.1	121.8	3.3	12/90	components
49	48	**Quantum** Milpitas, Calif.	30.0	446.3	47.2	3/90	peripherals
50	18	**Flextronics** Fremont, Calif.	27.5	171.3	(36.7)	3/90	contract manufacturer

*Compounded average annual growth rate

(continued)

Fastest-growing companies

1990 rank	1989 rank	Company	Five-year sales growth* (%)	Fiscal 1990 sales ($ millions)	Fiscal 1990 profits ($ millions)	Fiscal year ended	Industry segment
51	52	**Applied Materials** Santa Clara, Calif.	26.6%	$567.1	$34.1	10/90	semconductor equipment
52	31	**Mentor Graphics** Beaverton, Ore.	26.1	435.2	23.6	12/90	software
53	50	**Inmac** Santa Clara, Calif.	25.3	288.4	3.6	7/90	communications
54	--	**Solectron** San Jose	25.0	204.7	7.4	8/90	contract manufacturer
55	74	**Applied Magnetics** Goleta, Calif.	25.0	368.3	(10.0)	9/90	peripherals
56	43	**Lotus** Cambridge, Mass	24.9	684.5	23.3	12/90	software
57	91	**DSC Communications** Plano, Tex.	24.3	519.3	20.3	12/90	communications
58	49	**Tandem** Cupertino, Calif.	24.0	1,865.9	121.8	9/90	computers
59	--	**Atari** Sunnyvale, Calif.	23.7	411.5	(20.8)	12/90	consumer electronics
60	44	**Apple** Cupertino, Calif.	23.7	5,558.4	474.9	9/90	computers
61	40	**Richardson Electronics** La Fox, Ill.	23.6	160.1	1.0	5/90	components
62	89	**Intel** Santa Clara, Calif.	23.5	3,921.3	650.3	12/90	semiconductors
63	39	**Stanford Telecom** Santa Clara, Calif.	22.5	89.4	(0.7)	3/90	government
64	41	**BancTec** Dallas	22.0	185.8	10.5	3/90	computer-based systems
65	36	**KLA Instruments** Santa Clara, Calif.	21.7	167.9	9.4	6/90	instruments
66	63	**Xicor** Milpitas, Calif.	21.5	91.2	(18.0)	12/90	semiconductors
67	54	**ASK Computer** Mountain View, Calif.	21.2	207.5	5.0	6/90	software
68	46	**Microsemi** Santa Ana, Calif.	20.8	88.9	(11.5)	9/90	semiconductors
69	65	**Westmark International** Seattle	20.6	484.9	18.7	12/90	medical equipment
70	55	**Loral** New York	20.5	1,274.3	77.5	3/90	government
71	33	**Emerson Radio** N. Bergen, N.J.	20.2	891.4	10.4	3/90	consumer electronics
72	60	**Amdahl** Sunnyvale, Calif.	20.2	2,158.8	184.0	12/90	computers
73	--	**Diasonics** Milpitas, Calif.	19.0	267.1	16.4	12/90	medical equipment
74	67	**Molex** Lisle, Ill.	18.6	594.4	62.1	6/90	components
75	53	**Hutchinson** Hutchinson, Minn.	18.4	122.4	5.3	9/90	components
76	--	**Sensormatic** Deerfield Beach, Fla	18.3	191.3	20.0	5/90	computer-based systems
77	--	**MAI Systems** Tustin, Calif.	18.2	389.5	(64.5)	9/90	computers
78	88	**Medtronic** Minneapolis	18.1	836.6	108.7	4/90	medical equipment
79	--	**Exide Electronics** Raleigh, N.C.	18.1	172.4	5.0	9/90	components
80	--	**Dionex** Sunnyvale, Calif.	18.1	80.6	13.0	6/90	instruments
81	37	**Telxon** Akron	17.5	143.4	(14.4)	3/90	computer-based systems
82	68	**SCI Systems** Huntsville, Ala.	17.0	1,179.0	2.3	6/90	government
83	--	**LAM Research** Fremont, Calif.	16.9	137.3	(8.8)	6/90	semiconductor equipment
84	92	**Pacific Scientific** Newport Beach, Calif.	16.4	183.9	1.5	12/90	instruments
85	87	**Keithley Instruments** Cleveland	16.4	100.6	3.4	9/90	instruments
86	--	**Norstan** Maple Grove, Minn.	16.3	115.6	(0.8)	4/90	communications
87	45	**Cray Research** Minneapolis	16.2	804.4	113.0	12/90	computers
88	94	**Tellabs** Lisle, Ill.	16.1	211.0	8.1	12/90	communications
89	69	**ADC Telecom** Bloomington, Minn.	15.8	259.8	22.9	10/90	communications
90	61	**Valid Logic Systems** San Jose	15.6	158.5	(44.1)	12/90	software
91	72	**Marshall Industries** El Monte, Calif.	15.4	543.7	20.1	5/90	distribution
92	86	**Hewlett-Packard** Palo Alto, Calif.	15.3	13,233.0	739.0	10/90	instruments, computers
93	95	**Genicom** Waynesboro, Va.	15.1	255.3	1.1	12/90	peripherals
94	--	**National Computer** Minneapolis	15.1	315.3	13.0	1/91	software
95	78	**Unisys** Blue Bell, Pa.	15.0	10,111.3	(436.7)	12/90	computers
96	--	**Motorola** Schaumburg, Ill.	14.8	10,885.0	499.0	12/90	semi, communications
97	56	**Ultimate** East Hanover, N.J	14.8	209.7	0.1	4/90	software
98	--	**Titan** San Diego	14.7	124.0	2.2	12/90	government
99	77	**Intergraph** Huntsville, Ala.	14.7	1,044.6	62.6	12/90	computers
100	85	**Evans & Sutherland** Salt Lake City	14.6	157.6	16.6	12/90	computers

*Compounded average annual growth rate

Source: Electronic Business *(continued)*

Facts behind the figures

Rules of the game

Like any competition, the ELECTRONIC BUSINESS fastest-growing company ranking has rules. That means a company you might have expected to see on the list did not make it. For example, Conner Peripherals, Chips and Technologies, and several other companies listed on the right did not make our list because they did not have sales in our base year, 1985. SynOptics had sales recorded in 1985 but not for the entire year. Network Equipment Technologies, Cirrus Logic, and Encore Computer did not qualify since their 1985 sales were under $1 million. Other rules: The company must be U.S.-based and publicly held; 50% or more of its total revenue must be from electronics sales; and sales for fiscal 1990 must be $80 million or more. ☐

Who didn't make the list

Company	1990 sales ($ millions)	Why they didn't make it
Chips and Technologies	$ 293.4	First full year of sales in 1986
Conner Peripherals	1,337.6	No sales until 1987
Exabyte	170.3	No sales until 1987
Executone Information Systems	280.5	Company formed in July 1988
Mips Computer Systems	152.3	No sales until 1986
Network Equipment Technologies	180.8	Base year (1985) less than $1 million in sales
Cirrus Logic	85.0	Base year (1985) less than $1 million in sales
Encore Computer	215.2	Base year (1985) less than $1 million in sales
SynOptics Communications	176.0	First full year of sales in 1986

New arrivals to the fast track . . .

Company	Five-year sales growth*	1990 sales ($ millions)	1990 rank
Teradata	139.8%	$224.2	1
Sequent Computer	124.9%	248.8	2
Komag	109.9%	149.9	4
Dallas Semiconductor	104.4%	100.0	5
Octel Communications	103.0%	127.8	6
Everex Systems	87.6%	436.5	7
Dell Computer	74.6%	546.0	11
Convex Computer	73.0%	209.3	12
Interleaf	60.5%	88.8	16
BMC Software	58.3%	93.0	17.

. . . and those that have departed

			1989 rank
Wyse Technology	NA	NA	22
Ashton-Tate	13.7%	230.5	25
Digital Communications	13.5%	203.2	42
Computer Task Group	NA	NA	57
Western Micro Technology	12.8%	84.3	58
Bolt Beranek and Newman	13.4%	261.9	59
Dynascan	10.2%	169.0	62
Dynatech	12.6%	433.3	64
Digital Equipment	14.1%	12,942.5	66
Daisy Systems	NA	NA	70

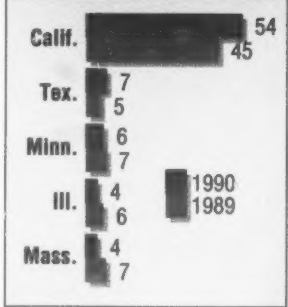
NA=Information not available due to acquisitions or change in operating status

* Compounded average annual growth rate

Hearty hellos

Welcome to 27 new companies who made the 10 fastest-growing company list this year. Most of the companies who are newcomers are being added to the 1991 list as they reach the prerequisite age of six years old. The number-one and number-two fastest growers, Teradata and Sequent Computer, made it with over $200 million in annual sales in fiscal 1990. Motorola made it back—just barely—in position number 96. Of course, 27 newcomers means 27 companies that are gone from last year's list. Three departing companies that ranked highest last year but didn't return this year (through failure to perform or acquisition) include Wyse Technology, Ashton-Tate Corp., and Digital Communications Associates. The remaining companies that didn't return were in the bottom 50 of the ranking in 1989. ☐

Where they are located



Here I come!

California's high-tech soil was rich and fertile again in 1990. Fifty-four of the fastest-growing companies are located there, with nearly half of those from Silicon Valley alone. (In 1989, California claimed 45 of the 100 fastest-growing companies.) Texas contributed 7, and Minnesota had 6 this year. Meanwhile, hard-hit Massachusetts and New York saw the number of fast-growing companies decline drastically. ☐

How the fastest continue performing

Fastest-growing electronics companies through the years

Year ranked	Fastest-growing company	Where they are today
1990	**Teradata**	Ranked #1 with 139.8% growth on sales of $224.2 million
1989	**Cypress**	Ranked #14 with 66.9% compound growth rate on sales of $225.2 million
1988-87	**Sun Microsystems**	Ranked #8 this year with 84.5% growth and #4 last year with 114.5% growth
1986	**MiniScribe**	Acquired by Maxtor (ranked #20) last summer
1985	**Convergent Technologies**	Acquired by Unisys (ranked #95) in September of 1988
1984	**TeleVideo**	Fiscal year sales fell to $45.6 million

Where are they now?

The 1989 winner, Cypress Semiconductor, has dropped to a still respectable number 14 on this year's fastest-growing list. The two-time winner (in 1987 and 1988) Sun Microsystems continues to shine, placing 8th this year and 4th last year. Two former fast-growing winners, MiniScribe and Convergent Technologies, were acquired. MiniScribe, the troubled disk-drive maker, sold most of its assets to Maxtor, a maker of data-storage products, last summer. Computer systems maker Convergent Technologies was acquired by Unisys in the fall of 1988. Meanwhile, revenue for 1984 winner TeleVideo actually fell in the latest fiscal year to $45.6 million. The microcomputer maker's sales peaked at $173 million in fiscal 1983 and have been steadily declining ever since. ☐

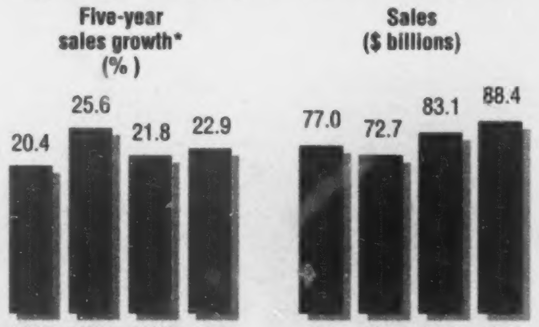
Hurrah for 1990

All 100 of the fastest-growing companies averaged 22.9% five-year sales growth in the 1990 ranking, up one point from the year before. (Five-year sales-growth figures were calculated at a compounded average annual rate from fiscal 1985 to 1990.) This year's fastest growers had the second-best five-year growth rate since ELECTRONIC BUSINESS began compiling the ranking in 1985. On average, each company in the top 100 sold $88.4 billion worth of products and services in 1990, up over $5 billion from the previous year. In 1986 the 100 fastest growers averaged 13.6% five-year sales growth, but their fiscal 1986 sales hit $129.2 billion.

Over one-fifth of the fastest-growing companies are computer makers. With combined sales of $32 billion, they represent over one-third of total sales. The next two largest groups are peripheral and software makers. ☐

The overall picture

Figures for the fastest-growing electronics companies



* compounded average annual growth rate

Big, and getting bigger fast

Perhaps the most amazing companies in the ELECTRONIC BUSINESS 100 fastest-growing list are those that are big and still manage to grow rapidly. This year, 16 fast-growth companies had over $1 billion in sales in fiscal 1990. This outstanding group grew sales nearly 21% on average over the past five years and accounted for 72% of all the 100 fastest-growers' sales.

Although the largest electronics and computer company—IBM, with 1990 sales of $69 billion—wasn't on the list, other top ten companies still fast-growing including Hewlett-Packard and Motorola. ☐

The billion-dollar club

Company	Five-year sales growth*	1990 sales ($ millions)	1990 rank
Sun Microsystems	84.5%	$2,466.2	8
Seagate Technology	62.2%	2,413.2	15
Microsoft	53.2%	1,183.4	22
Compaq Computer	48.2%	3,598.8	26
Computer Associates	41.6%	1,296.0	30
Western Digital	41.4%	1,070.5	31
Tandem Computers	24.0%	1,865.9	58
Apple Computer	23.7%	5,558.4	60
Intel	23.5%	3,921.3	62
Loral	20.5%	1,274.3	70
Amdahl	20.2%	2,158.8	72
SCI Systems	17.0%	1,179.0	82
Hewlett-Packard	15.3%	13,233.0	92
Unisys	15.0%	10,111.3	95
Motorola	14.8%	10,885.0	96
Intergraph	14.7%	1,044.6	99

* Compounded average annual growth rate

Peripherals outrace fast-growth markets

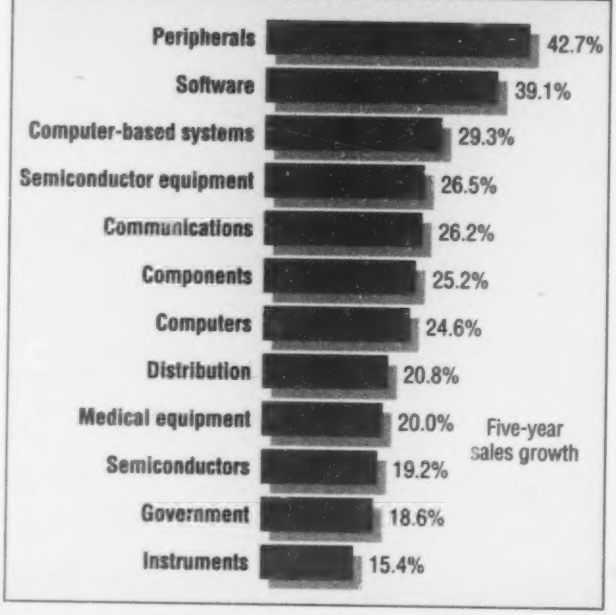
Fast growth by 12 manufacturers of computer peripheral equipment pushed the peripherals market segment growth above the software group, reversing last year's trend. With Komag at number 4 and Seagate Technology at 15, the peripherals market continues to be a hot spot in the electronics industry. Software makers, including 15 companies in the fastest-growing list, saw their five-year compounded growth rate slow from 46% in 1988, to 44% in 1989, and to 39% in 1990. Still, not a bad showing this year thanks to fast-growth companies such as this year's third-place company, Oracle Systems.

Despite the fact that the two fastest-growing companies in 1990, Teradata and Sequent Computer, are both computer companies, the computer market segment saw a five-year average growth rate of just 25%.

The semiconductor market, which had seen 29% long-run growth in 1988 and 23% growth in 1989, slowed to just 19% five-year average growth this year. With 11 companies in this segment, Dallas Semiconductor boosted the group's overall growth; but Motorola, with $10.9 billion in sales in 1990, brought down the group's weighted average gain.

Communications added six companies to the fastest-growing list and saw an average 26% five-year growth. Octel contributed to the group's success. ☐

The fastest-growing segments



An in-depth look at the fastest-growing industry segments

Communications (6)*	Five-year sales growth**	1990 rank
Octel Communications	103.0	6
3Com	47.7	27
DSC Communications	24.3	57
Weighted average	**26.2**	

Components (6)*	Five-year sales growth**	1990 rank
Vishay Intertechnology	51.1	23
Data Switch	30.1	48
Richardson Electronics	23.6	61
Weighted average	**25.2**	

Peripherals (12)*	Five-year sales growth**	1990 rank
Komag	109.9	4
Seagate Technology	62.2	15
Maxtor	56.7	20
Weighted average	**42.7**	

Computers (21)*	Five-year sales growth**	1990 rank
Teradata	139.8	1
Sequent Computer	124.9	2
Everex	87.6	7
Weighted average	**24.6**	

Computer-based systems (6)*	Five-year sales growth**	1990 rank
Symbol Technologies	75.4	10
FileNet	56.9	19
Intermec	31.2	46
Weighted average	**29.3**	

Semiconductors (11)*	Five-year sales growth**	1990 rank
Dallas Semiconductor	104.4	5
Cypress Semiconductor	66.9	14
Western Digital	41.4	31
Weighted average	**19.2**	

Distribution (2)*	Five-year sales growth**	1990 rank
Anthem Electronics	31.4	45
Marshall Industries	15.4	91
Weighted average	**20.8**	

Government (4)*	Five-year sales growth**	1990 rank
Stanford Telecom	22.5	63
Loral	20.5	70
SCI Systems	17.0	82
Weighted average	**18.6**	

Semiconductor equipment (3)*	Five-year sales growth**	1990 rank
Silicon Valley Group	38.0	38
Applied Materials	26.6	51
LAM Research	16.9	83
Weighted average	**26.5**	

Instruments (5)*	Five-year sales growth**	1990 rank
KLA Instruments	21.7	65
Dionex	18.1	80
Keithley Instruments	16.4	85
Weighted average	**15.4**	

Medical equipment (4)*	Five-year sales growth**	1990 rank
Applied Biosystems	34.9	40
Westmark International	20.6	69
Diasonics	19.0	73
Weighted average	**20.0**	

Software (15)*	Five-year sales growth**	1990 rank
Oracle Systems	111.1	3
Cadence Design Systems	70.4	13
Interleaf	60.5	16
Weighted average	**39.1**	

*Number of companies included in segment

**Compounded average annual growth rate

Japanese makers take aim at fast-growing static-RAM market

High-volume makers dominate the market's low end. Now they are eyeing the high end. U.S. makers could suffer severe price erosion

BY DAVE WEBB

As the market for higher-performance personal computers heats up, the demand is rising rapidly for very fast static-RAMs (SRAMs) used as cache memories. That could be good news for Japanese SRAM makers and bad news for domestic vendors. Indeed, several domestic SRAM makers have already called it quits, notably National Semiconductor, Advanced Micro Devices, Philips Components, Saratoga Semiconductor, and VLSI Technology.

The Japanese already dominate the slower segments of the SRAM market. Now they are starting to target the faster end of the market for chips with speeds of 20-nanoseconds and under. Competition from the high-volume, cost-efficient Japanese manufacturers may force the domestic vendors into smaller and less profitable niche application markets. The days of cozy competition and juicy profits are over.

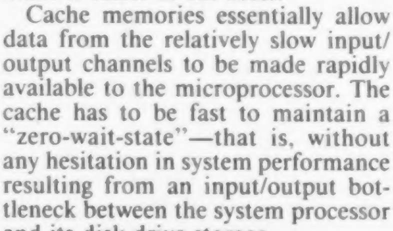
"The Japanese are definitely moving into the very fast end of the market," says SRAM market analyst Walt Lahti at In-Stat Inc. in Scottsdale, Ariz. "U.S. companies are still very strong, but I think that market segment is getting big enough to attract the really big players."

According to the market research firm Integrated Circuit Engineering Corp. (ICE) in Scottsdale, Fujitsu leads the pack with an 11% market share, closely followed by Toshiba, Hitachi, NEC, and Mitsubishi. The Japanese garnered 40% of the $2.9 billion worldwide MOS SRAM market in 1990, ICE estimates.

Any aggressive SRAM pricing moves by the Japanese companies would be particularly welcomed by developers of 80386- and 80486-based personal computers. Price/performance is a critical competitive issue in the PC marketplace where cheaper fast SRAMs will help keep system prices down. The same is true for vendors using Motorola's 86030 and 86040 chips and for the vendors of RISC systems, such as those based on Sun Microsystems' Sparc architecture. For them, cheap cache SRAMs make it easier to cut costs.

Cache memories essentially allow data from the relatively slow input/output channels to be made rapidly available to the microprocessor. The cache has to be fast to maintain a "zero-wait-state"—that is, without any hesitation in system performance resulting from an input/output bottleneck between the system processor and its disk-drive storage.

Some Japanese manufacturers make no secret of their aims in fast SRAMs. Ken Pope, Hitachi America's memories and mass storage strategic program manager, says Hitachi has "always been a player in the fast SRAM market," but now the company sees more opportunity in high-end PC and workstation cache memory markets.



Ken Pope, strategic program manager for Hitachi's Memories and Mass Storage Division

"We have seen a lot more caches in high-end PCs in recent months, and while we ship across the spectrum [of static-memory chips], that is a market you can be sure we will focus on," Pope says. Hitachi is aggressively marketing fast 1-Megabit SRAMs and is pioneering the yet-to-emerge fast 4-Mb market.

"Until two years ago fast SRAMs were a niche," says Integrated Device Technology Inc.'s vice president of marketing Larry Jordan. "Now, any system that has been designed in the last two years with [a clock speed of] 25 Megahertz uses a fast SRAM for cache, and as that performance demand curve rises, so will demand for SRAM speed and density."

Jordan agrees that offshore vendors will have to be contended with in the high end very soon. "As it grows past the $1 billion mark here, there are some well-defined parts—the Intel system standard cache market, as an example—that the Japanese will dominate by virtue of their manufacturing power," Jordan says.

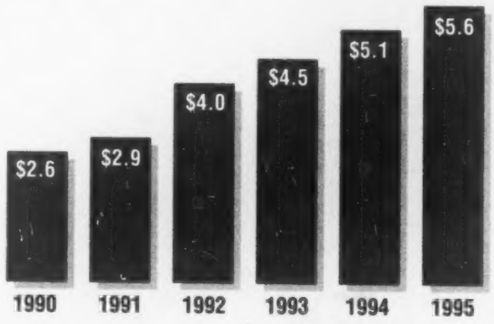
Other markets for fast SRAMs beyond PC cache memories are main memory applications in portable computers and computer-control applications. Hitachi expects to target these markets too, says Pope.

The worldwide market for NMOS, CMOS, and BiCMOS SRAMs is expected to reach $2.9 billion this year, according to ICE, who predicts that the market will grow to $4 billion next year, $4.5 billion in 1993, $5.1 billion in 1994, and $5.6 billion in

1995. Japanese vendors now control 43% of the market, with U.S. and Canadian vendors taking up 35%. ICE estimates that Europe and the rest of the world account for the other 25% of the market.

SRAM market on the rise

total worldwide revenue, MOS SRAMs ($ billions)



Source: Integrated Circuit Engineering Corp.

Dataquest projects the worldwide market for very fast SRAMs (less than 20 nanoseconds access time) will grow 17.5% this year. In 1990 the market was $312 million; this year the market is expected to grow to $378 million. Dataquest estimates revenue will climb to $537 million in 1992, $772 million in 1993, and $855 million in 1994.

In the second half of last year the SRAM market was in a volatile state. Too many vendors were shipping products into a softening market, creating price erosion that caused several U.S. vendors to abandon the market. Pricing has since stabilized, but if demand slacks off again more vendors may decide to quit.

"There are still more than 40 players in this market," says In-Stat's Lahti. "That is a lot for a market that is near $2.5 billion—more than the market can comfortably support."

"I agree with that," says Motorola's fast SRAM marketing manager Curt Wyman. "But if you look at the major players, I wouldn't imagine you would see much change. The little guys always come and go. The perspective to consider is that this was once a high-margin business; now you don't have the margins that attracted people to the market."

In-Stat reports that out of the 36 vendors in the under-35-nanosecond marketplace, Cypress and IDT are the worldwide market leaders, with Toshiba now the top player from Japan in that segment, Hitachi coming on strong, closely followed by Korea's Samsung Semiconductor.

"Something is going to have to happen to make room for these big guys," In-Stat's Lahti says, adding that fast SRAM players without manufacturing clout may have to follow Motorola's example and target application-specific SRAM markets.

Ione Ishii, a Dataquest semiconductor industry analyst, says Motorola has been exceptionally successful since its SRAM business essentially came out of nowhere in the last year and a half. "They are really growing fast in that market," Ishii said. "They grew 35% in 1989, and they were the only U.S. company with double-digit revenue growth in that market last year."

According to Motorola's Wyman, the company's success is a byproduct of its core microprocessor business. The company aggessively positioned its cache SRAM business in line with its other microprocessor and memory chip products to market to its large-system customers.

The company has managed to make enormous strides in growing its application-specific SRAM sales as well, an area which made up 20% of its 1990 sales revenue. "The number of dollars generated by SRAM sales has grown significantly for us in the last year," Wyman reports. "And application-specific statics helped out tremendously."

IDT's strategy is to remain a supplier at the top end of the market. "There is nothing in the formula for success that says the Japanese will change. They will always avoid building specialized parts. The fast SRAM market is growing large enough to attract them, but when the market gets to $1 billion, we will be addressing the $150 million segment at the top end."

With the expected increases in personal computer system performance, just about every system being shipped several years from now will have SRAM cache memory chips, Jordan and others say. The key for U.S. vendors will be to stay ahead of the performance and density curves just as Motorola and IDT say they are doing. ☐

A Static-RAM Primer

Static-RAM chips vary greatly in performance, density, and process design. Typically, SRAM access speeds range from 120 nanoseconds to as fast as 10 nanoseconds. The slow market is composed of vendors marketing 70-nanosecond and slower chips. The fast market is made up of makers selling 25-nanosecond to 70-nanosecond access chips. The very fast encompasses those chips faster than 25 nanoseconds.

Densities, another word for the data capacity of an SRAM chip, range from 4 kilobits to 16K at the obsolete end of the market to 4 Mb at the top. The biggest markets at the moment are the 64K and 256K segments. Some vendors are shipping 1-Mb chips, but that is an emerging segment.

SRAM silicon processes include the MOS family of NMOS, CMOS, and the bipolar/CMOS hybrid, BiCMOS. Bipolar family processes include TTL, which is quickly becoming obsolete, and ECL. The ECL architectures are the fastest static-RAM chips available and are used in mainframe and supercomputing applications.

Chips are also sold according to their architectural design. Designations such as "8K x 8" refer to the number of rows of bits and their arrangement on the chip. An 8K x 8 chip has 8 rows of 8 bits each, which would mean it is a 64K chip.

SRAMs, as a result, range from 1-Mb 35-nanosecond 256K x 4 BiCMOS chips to 4K 8-nanosecond 4K x 1 CMOS SRAMs, with a gamut of combinations in between. ☐

Desktop scanning moves into the office

Putting documents and images into desktop computers is a growth business. But can output technology keep up?

BY JOHN PARKER

The ability to put images into a computer gave the scanner market its first push. Transferred to documents, the technology became a boon to office efficiency. Now, the ability to scan both words *and* pictures is creating a whole new market in computer applications—and some impressive sales growth as well.

In the desktop-publishing industry, where it all began, scanner sales should grow from $156 million in 1989 to $290 million in 1993, according to market researcher BIS Strategic Decisions in Norwell, Mass. Market Intelligence Research Group Co. in Mountain View, Calif., puts combined optical character recognition (OCR) and image-scanner sales at $520 million in 1994, compared with $264 million in 1987.

OCR and image scanning begin life in the same fairly conventional optical technology. The key hardware components are charge-coupled devices (CCDs), a combination of a light source, mirrors, and a row of photodiodes that sense the light reflected from the scanned object. The result is a matrix, or "bit map," of the image or document. Users can edit the resulting document file or alter the resulting image file on their PC or Mac.

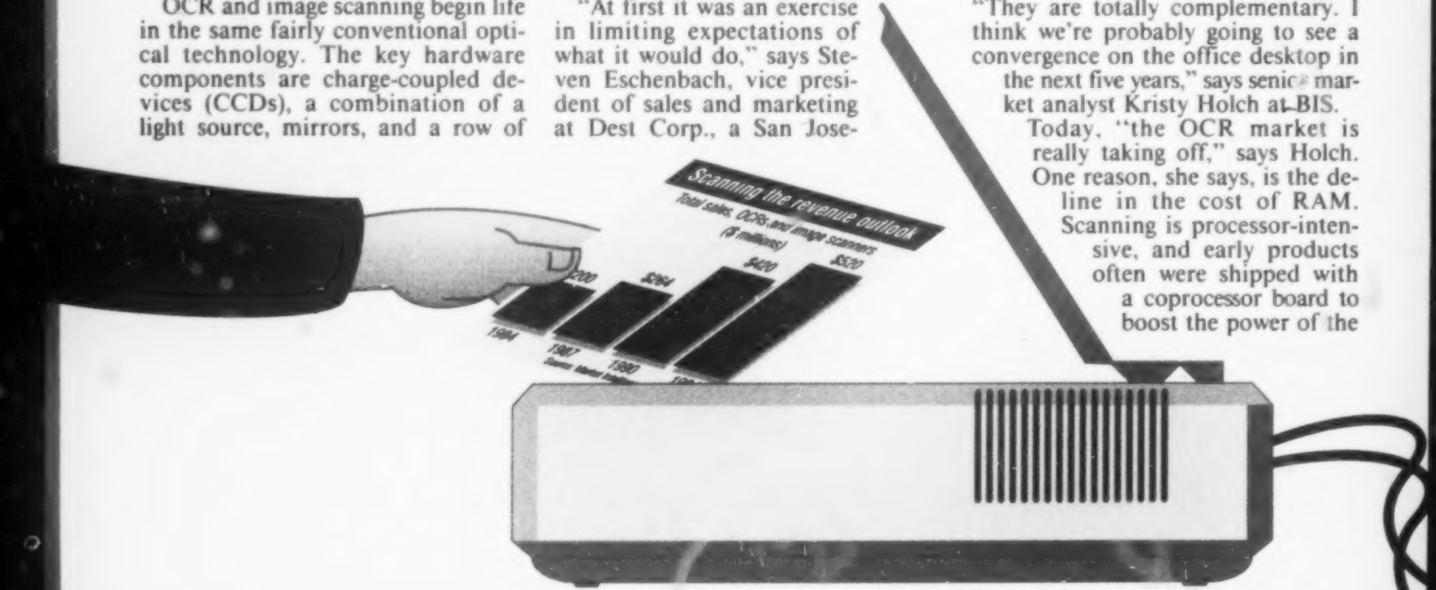
Scanner hardware, or "engines," are fairly standard. What differentiates scanner products is software: In order for the computer to analyze the bit map, formulas and algorithms are needed. OCR is primarily a software product, and for OCR vendors the main costs essentially are software development. Early OCR packages could recognize only a single font; today's omni-font OCR packages read the document by recognizing the basic shape of the character.

"At first it was an exercise in limiting expectations of what it would do," says Steven Eschenbach, vice president of sales and marketing at Dest Corp., a San Jose-based manufacturer of OCR hardware and software. Dest introduced OCR for desktop document use in the 1970s, but its first product couldn't read typeset copy, such as magazines and newspapers. In 1986, Dest introduced a $3,000 desktop unit that read about a dozen type styles. The scanner contained a microprocessor because matrix-matching took too much power for the desktops of the day.

Eschenbach calls 1986—the year that saw the coining of the phrase "desktop publishing"—the pivotal year for desktop scanning. "Suddenly, people wanted pictures in their computers," he says, and "all the little bits of the technology came together."

OCR and image scanners no longer represent two separate markets. "They are totally complementary. I think we're probably going to see a convergence on the office desktop in the next five years," says senior market analyst Kristy Holch at BIS.

Today, "the OCR market is really taking off," says Holch. One reason, she says, is the decline in the cost of RAM. Scanning is processor-intensive, and early products often were shipped with a coprocessor board to boost the power of the



desktop computers on which scanning software was supposed to run.

The office, not desktop publishing, represents the growing market, even though it was publishing that got scanning started, says Holch. "Getting a document into your office computer has become very desirable. We're seeing scanner sales tied to software sales, as well as the other way around."

It's not hard to understand the appeal of document scanning in the modern office, given that word-processing is still the major office desktop software application. The American Bar Association calculates it takes 15 uninterrupted minutes to retype a page from a legal document into a word processor, while it takes just 6 minutes to scan the same document into the office computer.

Teaming up

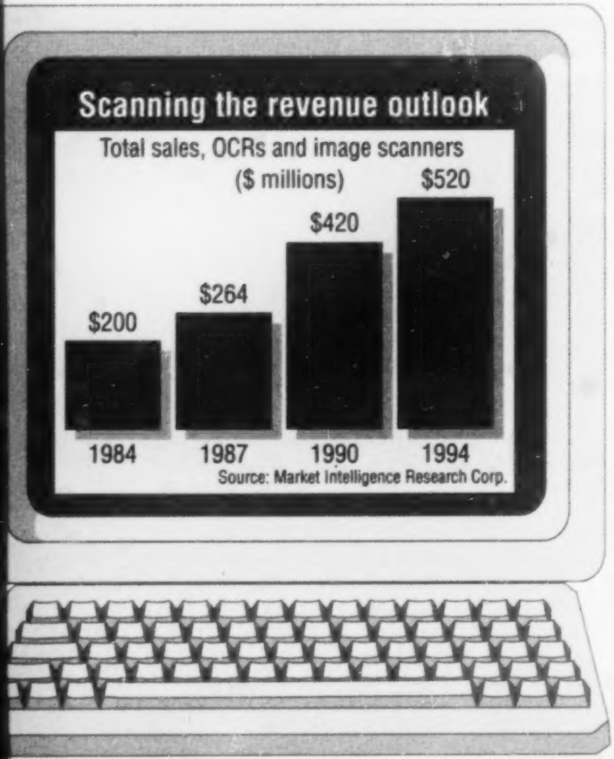
Office applications should multiply as scanning moves into the central processing unit of the desktop computer. An example may be facsimile transfer. Experts say software soon may convert faxes to finished documents and route those documents to your computer. Page-layout packages will have a scanning option on menu. A scanner may digest a magazine page, pictures and text, with one scan and dump it onto the network. "We're growing toward a lot more integration," says Holch. "For software and hardware makers, it will be important to make strategic alliances with OEMs."

Such partnerships are important to Calera Recognition Systems Inc. of Santa Clara, Calif., an OCR-dedicated company whose products range from $600 scanning software to a $30,000 high-speed scanner for which Calera makes software and hardware. A recent agreement with Kodak calls for use of Calera software in a scanner that reads forms at high speed—an application in big demand among insurance companies, for example. "We're looking at a number of those partnerships," says Barney Dewey, Calera's vice president of product development.

One future partnership, says Dewey, might involve a digital copier. Such a machine, he says, might have a "copy" button and a "read" button. The "read" command could scan and store images and documents for future use. "OCR is getting integrated into other applications," says Dewey, citing the integration of Calera's WordScan into Microsoft's Word for Windows.

The Windows environment itself will have a powerful effect on the scanner market, says Dewey, by extending the graphical capabilities of MS-DOS users. In the graphics-oriented world of the Macintosh computer, per-capita use of scanners is higher than it is among users of DOS-based PCs. Predicts Dewey, "Windows will change that."

The change has begun. When Micrografx Inc., a high-flying Richardson, Tex.-based developer of Windows applications, went shopping for its first acquisition late last year, it went all the way to Londonderry, N.H., offering $5.1 million for Astral Development Corp. The deal gives Micrografx, with $17.8 million in sales, a product that will let users edit images in Windows. For Astral, the deal means product-development money and a retail distribution channel for its Picture Publisher image-editing software. The acquisition was completed early last month, with Micrografx issuing 250,000 shares of its own stock in exchange for the stock of Astral.


Scanning the revenue outlook

Total sales, OCRs and image scanners ($ millions)

Source: Market Intelligence Research Corp.

Further evidence of the merging of scanning technologies can be found in Cambridge, Mass., where Xerox Imaging Systems Inc. recently moved its headquarters from Sunnyvale, Calif. XIS is a combination of three efforts: parent company Xerox Corp.'s emphasis on office systems, Kurzweil Computer Products' omnifont document scanner technology, and Datacopy's imaging expertise and established distribution channel.

According to Wayne Crandall, vice president for sales and corporate marketing at XIS, the company's strategy is based on four product lines: one for the PC, one for the desktop, and one for the Sun workstation environment, in addition to the Kurzweil Personal Reader line of scanning products for the visually impaired (the products that got Kurzweil started in Cambridge in 1975).

Shifting price points

Increased demand, falling memory cost, improved software, and heightened competition combine to cut prices. When the desktop-scanner market got rolling in the late 1980s, packages cost $500 to $1,000 for the software alone. A four-bit scanner with 16-level gray scale went for $2,500. Now, says Holch, "you could buy a color scanner with that much money. Pentax offers a 16-level gray scale scanner for just under $1,000. The pricing decline will continue, though not as dramatically."

At the high end are $10,000-$20,000 high-speed scanners that appeal to document-intensive businesses such as banks, libraries, law firms, or drug companies. But the strongest dollar-sales growth is expected in the midrange market and represented by an office where a scanner sits next to the network printer. Such a scanner might fetch a street price of $1,200.

At the low end, the pace of unit

Xerox Imaging Systems divides its scanner technology across several product lines, says VP Wayne Crandall, including PCs and products for the visually impaired

shipments could create growth rivaling that of the midrange market, Holch says. Individual users might pay a $600 street price for a scanner that has no gray scale but that has a detachable scanning bar that lets it double as a page-feed or hand-held device. Users would pay another $200 to $300 for software.

"Meanwhile, you cannot overlook hand-held scanners selling at $200 to $700," according to Holch. "We thought they'd peter out, but they've enhanced their capabilities to the point where they are a great entry point for users. In fact, they support the whole scanner market by doing that."

Reigning champion of the midrange desktop-scanner market is Hewlett-Packard Co. Market analysts estimate HP's ScanJet product line holds a two-to-one advantage over its closest competitor. The Palo Alto-based company's strength in output technology with its LaserJet printers helped HP develop its scanner products for office use.

And HP apparently intends to keep its focus on the midrange. "There are definite limits on sheet-feed and hand-held design," says Gary Kaiser, marketing section manager for HP's Greeley (Colo.) Hardcopy Division. "We've done quite a bit to understand user needs. We're focused on people doing real work where they need something robust."

Selling to the scanner market

Major trends for OCR and scanner distribution:

- **Direct sales become less important as the role of high-end products diminishes;**
- **Manufacturer-distributor partnerships become more important with growth of midrange and low-end;**
- **Dealer distribution deals will continue as cheaper, simpler scanners become available;**
- **VARs and integrators will cash in because of their expertise in vertical markets.** ☐

Source: Market Intelligence Research Corp.

Input vs. output

The limits to scanner growth seem to have less to do with the technology of putting information into the desktop computer than with output. That's certainly the case with color scanning. Some say it will be 10 years before color scanners compete one-to-one with monochrome scanners. Others say it will never happen.

"The availability of a color scanner doesn't mean you have the solution," says HP's Kaiser. "It can even create more problems. Color is in our plans, but we want to deliver a really usable product."

Part of the problem is the huge bit load colored images create, says Holch. Another problem is the lag in developing color monitors. And a third is the lack of effective color printers. Your company might spend six months scanning images into the desktop and designing a new logo, for example, only to find the shade of blue you wanted can't be reproduced on paper.

Then there's the standards problem. "We need a standard interface for scanners," says Holch, "so that people writing scanning software don't have to write a separate driver for each scanner on the market. Right now, most scanners are compatible with TIFF [Tagged-Image File Format], so if worse came to worst, you could convert an image file just as you convert a document file to ASCII. But that's a lot to bother with."

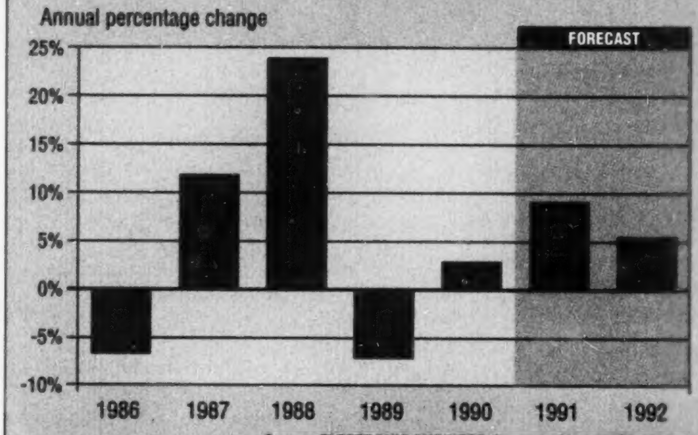
Astral Development made its name by tackling another key problem: All images are not created equal. They come from different sources, and they are output on different printers.

"No two CCDs are alike," says Astral president Frank Mazza. For example, the halogen lamps that are the scanner engine's light source can dim over time, and that affects the image that is transferred to the computer. Some of Astral's software is able to calibrate bit-mapping to compensate for flaws in the scanner. Other Astral software calibrates the dot-gain of a specific type of printer to match the scanner.

For OCR companies, the challenge of the next five years will be to move away from stand-alone software packages and make their products application-oriented, says XIS's Crandall. If companies meet this challenge, he says, users will be able to scan documents by manipulating an icon on their computer screen.

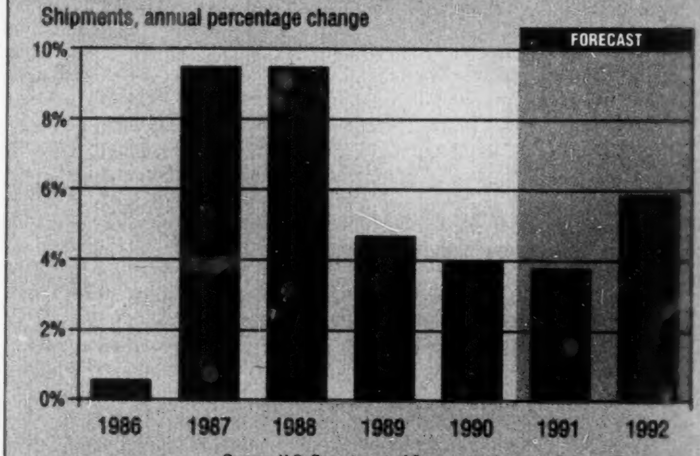
Calera's Dewey has his own vision of the future. "There are indications the scanner market will bifurcate," he says. "High-end scanner sales growth will go up, and at the same time there might be a market for a low-end scanner that does much of the job now done by a computer keyboard." ☐

ATE revenue will continue to revive in 1991...



Source: ELECTRONIC BUSINESS; forecast: Cahners Economics

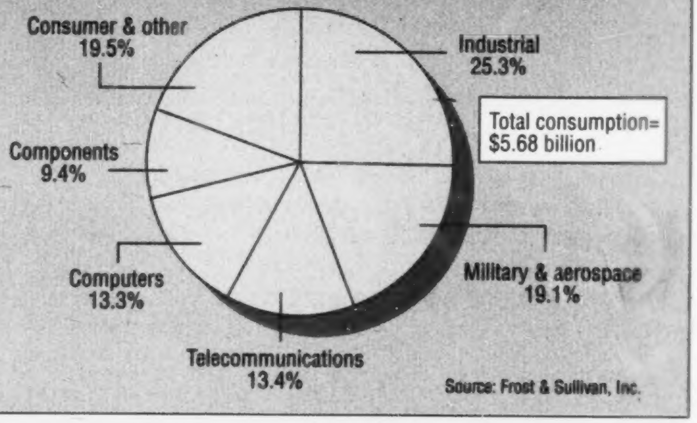
...and instruments growth will be steady...



Source: U.S. Department of Commerce; forecast: Cahners Economics

...thanks to these end markets

End markets share of test & measurement consumption in 1989



Source: Frost & Sullivan, Inc.

Instrument makers avoid repeat of '86 recession

The instruments and controls industry ended 1990 with its slowest annual sales growth in four years. U.S. factories shipped $53.2 billion worth of product last year, for an annual growth rate of 4%, down from 4.7% in 1989. Although modest, last year's gain compares favorably with the industry's anemic 0.6% growth rate during the 1986 slowdown.

At Cahners Economics, we expected the instruments market would reach its cyclical low point in its growth path at the end of 1990 before rising in early 1991. The recession has simply postponed an acceleration in shipments growth until the second quarter of this year. New orders rose just 2.9% in 1990, which will mean a weaker time for shipments in the first half of this year than we had originally predicted. We still expect the second half of 1991 to bring a rebound.

While the instruments market has slowed down, the current economic downturn cannot hold back the surging market for test and measurement equipment. According to New York consultants Frost & Sullivan, demand for test equipment is growing as the complexity of electronic devices increases 35% a year. The challenge for the instruments industry is to keep up with the aggressive pace of technology.

Consumption of test and measurement equipment will rise at a compounded annual rate of 9.6%, says Frost & Sullivan, from $5.68 billion in 1989 to nearly $9 billion in 1994. By end markets, industrial users bought $1.44 billion worth of test equipment and instruments, or 25% of the total in 1989. The next largest consumer, with a 19% share, was the military/aerospace industry.

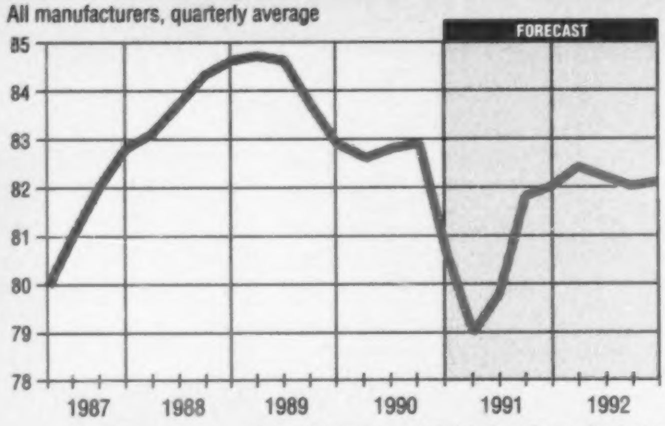
Within the test market, automatic test equipment is expected to increase its share from 26% in 1989 to 27% in 1994. ATE will continue to gain importance as technology accelerates and demand for better quality grows. The ELECTRONIC BUSINESS ATE sales index was rebounding as 1990 ended. For the entire year, revenue for the ATE companies in the survey recorded a 2.9% rise over 1989, reversing the prior year's decline. Cahners Economics forecasts growth will continue rising with a 9.1% gain to $2.31 billion in sales this year.

JOHN FARRELL

For more information on Cahners Economics' forecasting services, including seminars, newsletters, and database diskettes, contact Dan Buchan at (617) 630-2105; by fax at (617) 630-2100; or write Cahners Economics, Cahners Publishing Co., 275 Washington St., Newton, MA 02158

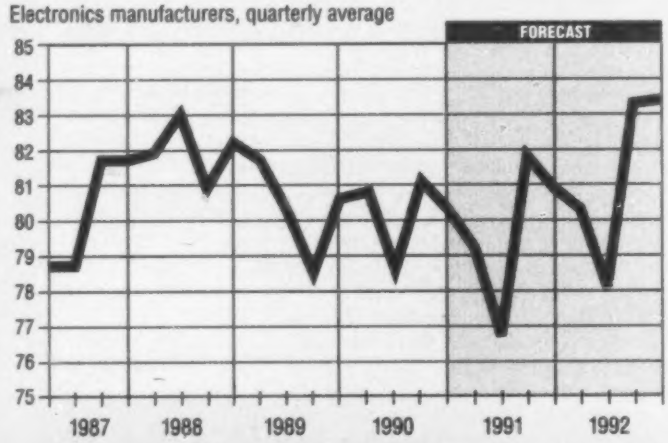
Until factory operating rates head back up...

All manufacturers, quarterly average



Source: Federal Reserve Board; forecast: Cahners Economics

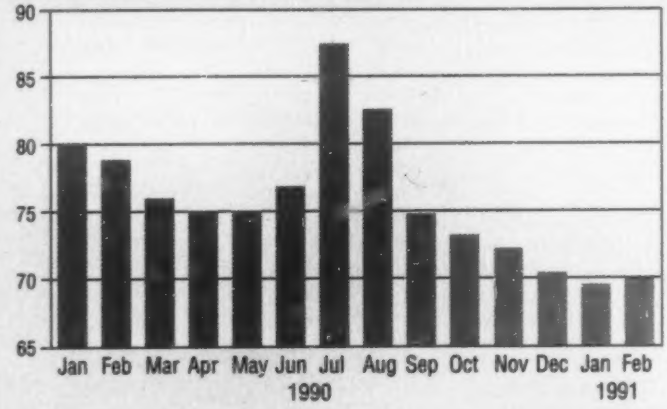
Electronics manufacturers, quarterly average



Source: Electronics Purchasing; forecast: Cahners Economics

...manufacturers won't be raising prices

Semiconductor price index: July 1989=100



Source: Electronics Purchasing

Weak demand forces utilization rates lower

Capacity utilization is uniformly low across the economy because of reduced market demand during the current recession. From a utilization rate of 83% in July, all manufacturing capacity utilization plunged to 78.8% in January—the lowest level since September 1986. With capacity utilization rates below their long-term averages, manufacturers will be able to increase production to meet customer demand during the next rebound without creating inflationary pressures.

According to a survey of 500 buyers made by ELECTRONIC BUSINESS's sister publication, *Electronics Purchasing*, the electronics industry is also operating with excess capacity. The electronics plant operating rate stood at 77.9% in February, down from 80% recorded in February 1990. Cahners Economics expects capacity utilization in the electronics industry to average 80% this year and increase to an average of 81.3% in 1992 when the economy picks up speed again.

Falling capacity rates and weak demand have put pressure on manufacturers to lower prices—or at least to keep from raising prices. The National Association of Purchasing Management's price index tumbled to 41.8 in February, their lowest price index level since December 1982. For the electronics industry in particular, connector prices dropped for the third consecutive month, as did prices for memory chips, microprocessors, and printed circuit boards, says the NAPM. This was the third consecutive month that prices dropped for printed circuit boards.

According to *Electronics Purchasing's* transaction price survey, semiconductor prices held steady from January to February 1991. When compared with February 1990, however, semiconductor prices fell 11%. Electronics OEM purchasers confirm this trend; 66% of the respondents reported prices for the products they buy are steady, and 8% say prices are falling. Only 6% report rapidly rising prices, and 20% say prices are rising slowly.

With excess capacity and weak demand, expect price declines to continue in the electronics industry in the short run. Later, when demand and production rise with the rest of the economy in the second half of 1991, it will be time again for inflationary worries.

JULIE HANDELMAN

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MAY 6, 1991

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Europe's satellite business ready to launch PAGE 50

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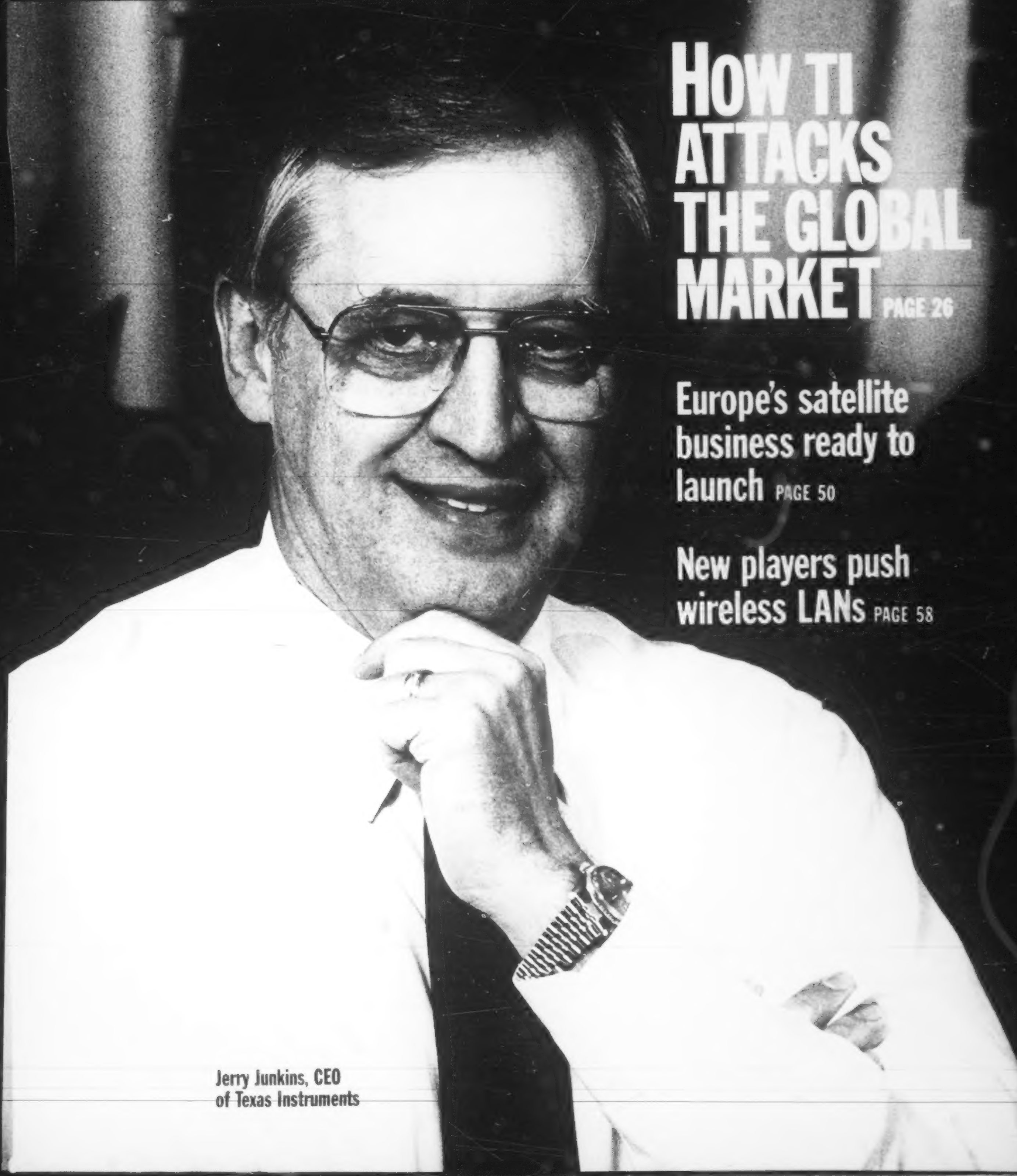

Jerry Junkins, CEO
of Texas Instruments

Electronic Business

FOR MANAGEMENT IN ELECTRONICS, COMPUTER, AND SYSTEMS COMPANIES – WORLDWIDE

VOL. 17, NO. 9 MAY 6, 1991

PAGE 26 Texas Instruments takes a closer look at its role in the marketplace under CEO Jerry Junkins

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26 How Texas Instruments attacks the global market

Changing one's image is never easy to do, but that's the challenge facing Texas Instruments. After much soul-searching, CEO Jerry Junkins has embodied a long-term vision known as TI 2000, which will help his company transform itself from old-guard to cutting-edge

Cover: Mark Perlstein

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Not long ago, Texas Instruments was known mostly for its massive ego. But now, under the guidance of CEO Jerry Junkins, the company has been born again and promises to strike new technology relationships while becoming better attuned to its customers' needs

28 Jerry Junkins: The man behind the renaissance

Accepting new ideas and implementing them seems to be common practice around TI these days. With Junkins in command, TI has taken on a new personality that bolsters creativity

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After years of licensing its patented technology to competitors for paltry sums to encourage competition, TI has finally began to collect. They have now received more than $700 million in royalties by merely protecting their patents

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Just-in-time management has taken some of the sting out of the latest electronics recession, especially compared with that of 1985. But the question remains as to how well the industry will be able to manage once the recession is over

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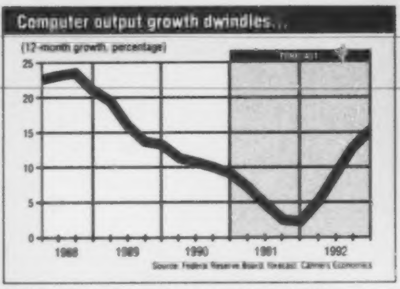

Source: Federal Reserve Board; forecast: Cahners Economics

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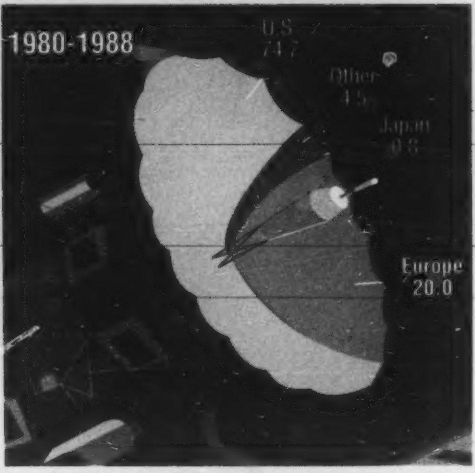

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U.S. satellite equipment manufacturers are beginning to invade the European communications market. With the European Commission setting many of the standards, U.S. companies will find it difficult to hold on to their 75% share of the world market

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52 Applied Materials combines the best of east and west

Over the past several years, many U.S. chip-equipment producers have lost sales and market share to Japan. But California-based Applied Materials has learned to combine Japanese management and U.S. technology in order to become profitable. Now the company earns nearly as much in Japan as in the U.S.

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Twenty years ago the average automobile contained less than $25 worth of sensors and microprocessors. By 1995 that same car will drive that figure to $900. But as the technology advances, there is no guarantee of quick payoffs to suppliers

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Taking the long-term view

CEO Jerry Junkins (left) with associate editor Peter Burrows

In this business there are a number of major players—and a lot of not-so-major players—that we keep close tabs on. One of the biggies is Texas Instruments. During the course of any given year the editors of ELECTRONIC BUSINESS will sometimes visit TI at its home base in Dallas, sometimes at its European headquarters in France.

Our most recent visit with CEO Jerry Junkins and several of his colleagues happened to be near our own editorial offices. Managing editor Garrett DeYoung, senior editor Rick Whiting, associate editor Peter Burrows, and I spent several hours with Junkins, executive vice-president of the defense systems group Hank Hayes, and vice-president of investor relations Max Post for a wide-ranging discussion of the electronics industry in general and TI's strategies in particular.

We'd known for some time that TI had developed a plan known as TI 2000, a series of strategies destined to guide the company to the year 2000. The plan focused on three questions: Where is the world going? What is TI's position in that world? How do we plan to get there? Three key questions that any major electronics company ought to be asking as we plow into a decade that promises to be much tougher than the '80s.

It was a refreshing change to hear a CEO and his colleagues talk about a vision for the decade. Junkins is aggressively pursuing innovative financing and protecting the company's intellectual property, particularly in the area of semiconductors, a core business for TI. Just how *is* TI going about its future business? Read Peter Burrows's cover story on page 26.

As Burrows was rushing off to Texas to cover the story, senior editor Elizabeth Baatz was poking around closer to home reporting on the unsettled outlook for New England's battered electronics and computer industry. Once the centerpiece of the "Massachusetts miracle," the companies on Boston's Route 128 are struggling to overcome a sluggish economy and to keep up with rapid changes in technology. Many companies in the Northeast have never had the long-term vision of a TI 2000 and are now regretting it.

All is not gloom and doom however. As we reported in our Mar. 4 issue, many electronics companies are beating the recession. And Elizabeth singles out four New England companies that are likely to boom as the economy gathers steam. Indeed, New England as a whole may benefit now that companies have tightened their belts and become more streamlined. Stay tuned.

JEFFREY BAIRSTOW, editor

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BPA ABP

SEMICONDUCTOR TRADE

A "single industry voice" gets results in chip wars

AFTER YEARS of bickering about how to stem allegedly unfair Japanese trade practices in semiconductors, America's chip and computer makers have forged a common vision. That vision, which was recently set forth by the Semiconductor Industries Association and the Computer Systems Policy Project, seeks to extend the 1986 semiconductor trade agreement between the U.S. and the Japanese governments. The agreement lapses in July.

The proposal conceals a number of compromises. For one, U.S. chip customers agree to extend through 1992 the target of a 20% share of the Japanese market for American chip suppliers; in the past, chip customers have feared that such "managed trade" policies could cause Japanese suppliers to pull back on production, thus limiting supplies of key components. For their part, chip makers—while still spooked by memories of the dumping that chased six of the eight U.S. DRAM makers out of business in the mid-1980s—agree to toned-down antidumping measures: Rather than authorize the U.S. Department of Commerce to set company-by-company price floors for imported commodity chips, the new plan takes government out of the loop until a complaint is filed.

"We have held divergent views [with the semiconductor industry] on many semiconductor trade issues," says Rod Canion, CEO and president of Houston-based computer maker Compaq Computer Corp. "But we realized a couple of years ago that arguing was not going to get us anywhere in Washington. We had a lot of common goals, and we decided to focus on those instead of on our differences."

For now, the new cooperation is playing well in Washington. Just weeks after the SIA/CSPP proposal was announced last October, members of the U.S. Trade Representative's office and the Commerce Department started negotiations with their counterparts in Japan's Ministry of Foreign Affairs and Ministry of International Trade and Industry. Since late January, there have been meetings roughly every two weeks between these bodies, says USTR spokesman Tim Richards, and the U.S. position has reportedly stuck close to the industry proposal.

"The industry consensus is almost unheard of," says Richards, "and it makes our job much easier." He points out that a single industry voice takes away a favorite negotiating ploy by the Japanese—playing off the interests of one industry sector against those of another.

Congress, which has yet to take a role in what has been a government-to-government gentleman's agreement, is also sounding bullish about the proposal. With anti-Japanese sentiment on the rise due to Japan's lack of military support for the Gulf effort and continued intransigence in the GATT talks and other trade issues, many lawmakers seem to have forgotten their fear of appearing to be in favor of "industrial policy." "We're certainly not in the business of picking winners and losers," says International Affairs Committee chairman Lloyd Bentsen (D-Tex.). "But there are some things that government can do."

Even Japan seems to be responding favorably. Although Japanese officials have opposed the extension on the grounds that progress is already being made, U.S. negotiators reportedly have been surprised at their willingness to talk—perhaps because the tone of the new proposal is less confrontational than the original version. "I expect the Japanese see this proposal as a reasonable way to get rid of some problems that aren't going to go away by themselves," says Canion.

PETER BURROWS

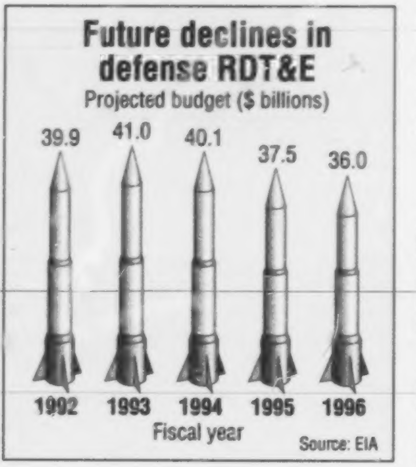
Compaq's Rod Canion and TI's Jerry Junkins, setting aside past computer/chip maker differences, in March brought a common vision for U.S.-Japan trade before Congress

DEFENSE

EIA sees decline in defense R&D spending

A PROJECTED decline in Department of Defense R&D spending is raising questions among defense electronics company executives about the future of the U.S. military's technology base.

The Electronic Industries Association predicts that the DOD budget for research, development, test, and evaluation (RDT&E) will begin to shrink in fiscal 1994. RDT&E, which totals $34.6 billion this fiscal year, is used to fund the development of



Future declines in defense RDT&E

Projected budget ($ billions)

Source: EIA

new electronics and weapons systems for the military, ranging from the smallest radiation-proof semiconductor to the B-2 Stealth bomber.

For fiscal 1992 the DOD is seeking from Congress $39.9 billion for RDT&E, an increase of 11.3% when adjusted for inflation. Increased spending for the Strategic Defense Initiative ("Star Wars") and the Advanced Tactical Fighter program account for much of the increase.

But RDT&E is expected to be only $41 billion in fiscal 1993—a real increase of only 0.9%—and is expected to shrink each year after that. Coming so soon after the Persian Gulf war, where high-tech weaponry proved so successful, the EIA predictions are setting off alarms.

At a recent Washington seminar, Geoffrey K. Bentley, business research manager for Textron Defense Systems, warned that the number of companies participating in military R&D is shrinking and threatens to erode the nation's technological edge.

Among the proposed remedies: Allow defense contractors to make a profit on R&D efforts. Now when defense companies sink huge sums of money into R&D, they are gambling that they will win big procurement orders from the Pentagon. Making money on the research itself—and thus reducing the gamble—will encourage more research, said C. M. Herzfeld, director of research and engineering at the DOD. "Industry can no longer subsidize R&D on projects that may never get built," he said.

But Herzfeld, who in essence is the Pentagon's chief technology officer, also issued a challenge to defense contractors. "I think RDT&E is here to stay," he said. "That's the good news. But it will change. What you want to do is look for the opportunities instead of crying about shrinking budgets."

RICK WHITING

SOFTWARE

A real market emerges for real-time systems

A MARKET for hardware-independent real-time operating systems (which permit computers to respond instantaneously to user commands) is blossoming for a handful of companies whose sales could skyrocket if their expectations materialize.

Makers of single-board computers and products with embedded microprocessors appear to be turning away from hardware-dependent and in-house real-time code to buy from companies such as Wind River Systems Inc., Ready Systems Corp., and Microware Systems Corp., which develop commercial real-time software.

"It's a $750 million market that could go to $1 billion next year," says Mitch Bishop, Wind River's director of marketing. "The reality is that real-time is arriving in the real world as an emerging marketplace."

Bishop says his Alameda, Calif.-based company's growth will double from $8 million in annual revenue for fiscal 1991 (ended Feb. 1) to $16 million next year. "There are a number of factors affecting that growth," he says. Traditionally, companies have built their own hardware and real-time operating systems but now want to get away from the hassles of redoing code every time new hardware is added. "They want shrink-wrapped software that will work on Intel, Motorola, or Sparc chips, not just a single architecture," he explains.

Wind River's Bishop: The real-time software systems market could reach $1 billion

Privately held Ready Systems in Sunnyvale, Calif., is the largest independent company in the market, with Microware of Des Moines a close second, and Wind River third. Dataquest analyst Doug Crook says that while it's difficult to determine the actual size of the real-time market, it's at least a $500 million market on the software side. "Last year we determined $1.3 billion went into real-time hardware, and operating systems are a component of that," he says. "It's a good strong niche market that an $8 million company can make money in."

DAVE WEBB

MULTIMEDIA

Multimedia: standards, but few products

MULTIMEDIA computers, whose bags of tricks include sound, animation, still images, and, in some cases, full-motion video, have yet to make much of a dent in the marketplace. But their potential impact could be huge, and vendors have been jockeying for years to ensure that they are positioned to exploit the market.

That activity has heated up in recent months. In March Microsoft Corp. of Redmond, Wash., announced that 11 hardware manufacturers had signed on in support of the software company's Multimedia PC (MPC) specification. Computers bearing the MPC mark would contain a 286 or a 386/486 microprocessor, 2 megabytes or more of random access memory, a 30-MB or larger hard disk, a 4-bit or 8-bit VGA video display, a digital audio subsystem, and a CD-ROM drive. They also would be compatible with Microsoft's Windows 3.0.

The MPC standard was seen in some quarters as a power grab by Microsoft, and one that was being counthe same time the EC is telling them their competitiveness rests in their own hands.

But ICL's ousting obviously doesn't mean that Jessi (within which IBM contributes to two projects) is cold to the idea of U.S. participation. In fact, Jessi officials long have privately called the consortium an "anti-Japanese" initiative.

This latest EC electronics policy presents no new initiatives and releases no additional EC funding. But it endorses the 12-member countries' funding of the European Nervous System, a proposed computer linking of EC public databases that is meant to increase demand for computer products and should be open to bids from U.S. companies. Redirection of funds is also a recommendation included in the new directive.

BARBARA BERKMAN

OPTICAL DRIVES

IBM could spur optical-drive market

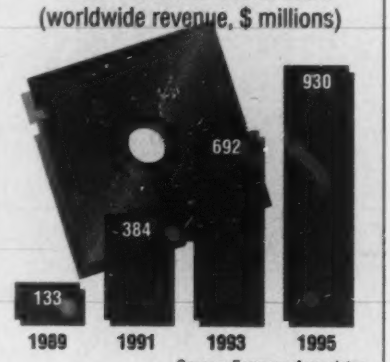
IBM MAY BE positioning itself to give the optical-drive market a much-needed shot in the arm. Big Blue has recently been showing a 128-megabyte 3.5-inch form factor magneto-optical (MO) disk drive, which analysts expect the company will offer with its next PS/2s.

The erasable optical drive market has been slow to emerge, and the jury is still out as to whether OEM systems vendors will adopt the devices as complementary storage alternatives to magnetic disk drives. But if IBM makes such a move, other OEMs may follow suit, pushing demand beyond the threshold that has kept vendors confined to low-volume captive and distribution markets.

"IBM has demonstrated a considerable interest in optical-drive technology," says Nicos Syrimis, senior marketing manager for Cirrus Logic Inc.'s mass storage unit. "This is what is really needed—one of the big guys coming along and adopting it to provide leadership. If IBM does follow through and backs it, that'll certainly give the market credibility."

For now, Hewlett-Packard and Next Computer Inc. are the only systems vendors shipping workstation systems with MO drives. Those drives are 600-MB 5.25-inch form factor devices, not 3.5-inch drives, and are being used in applications the 3.5-inch drives can't handle.

Erasable optical disk-drive market
(worldwide revenue, $ millions)



Source: Freeman Associates

"It's engineering workstation networks where you'll see [5.25-inch drives] showing up in any volume," says Jim Porter, president of Disk/Trend. "I fully expect companies such as Sun to use the 5.25-inch drives someday."

But the 3.5-inch models are being pegged to PCs. The other known vendor shipping OEM-bound 3.5-inch drives is Nakamichi Corp. of Japan. Porter says most of the Japanese vendors now shipping 5.25-inch drives all have 3.5-inch programs in the works but are likely to wait and see what happens to the market.

DAVE WEBB

FINANCIAL REPORTING

New guidelines for software sales?

JUST WHEN IS a software sale considered a sale? That question is usually relegated to the esoteric world of accounting, but the answer could mean millions of dollars for software vendors' revenue statements.

Under generally accepted accounting principles (GAAP), a sale can be listed on a company's books as revenue—specifically, an "account receivable"—only when the sale is a virtual certainty. But such standards are hazy when applied to the software industry. Customers, for example, may contract to buy a supplier's software one day, pay a license fee sometime later, and get the software up and running later still. Often products are not even "shipped" in the traditional sense; they may be transferred via phone lines. Further muddying the waters is when to account for revenue and expenses relating to training, maintenance, warranties, and upgrades—all major parts of the software business.

The result is that some software companies have been a bit too aggressive in counting *potential* sales as revenue, thus inflating their accounts receivable. In 1990, for example, database software vendor Informix Software Inc. listed 60% of its sales as accounts receivable because it counted a signed contract as a sale, rather than waiting until the license fee was paid.

All this has drawn the scrutiny of the federal Securities and Exchange Commission. To try and bring order to this chaos, the American Institute of Certified Public Accountants and Financial Accounting Standards Board have drafted accounting standards for the software industry. The 32-page proposed guidelines are now being circulated.

Adapso, a computer software and services industry association, and the Arthur Andersen & Co. accounting firm held forums on the proposed standards during March and April. The draft guidelines appear to have wide support, although some executives have proposed changes in sections dealing with software maintenance and other items. The AICPA comment period ends May 16.

But it is virtually certain the guidelines will be in effect by year's end. The SEC is already requiring newly registered software companies to abide by the guidelines. "If you are budgeting or planning for next year," Arthur Andersen's Richard Dieter said during a March 25 forum in Newton, Mass., "you must assume that this will become reality by late 1991."

One company taking such advice to heart is Informix. In January the company restated its 1990 income to comply with the more conservative accounting principles. The result: A $23.3 million accounting adjustment in the fourth quarter, and a loss for the year.

RICK WHITING

An unsettled outlook for New England electronics

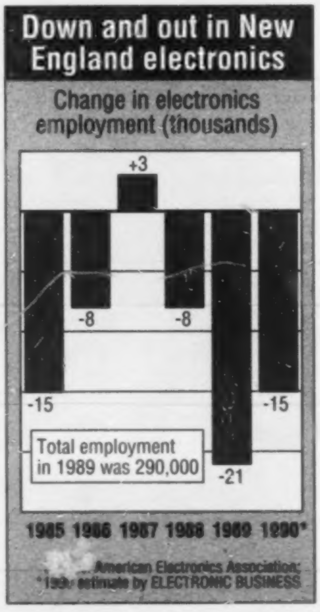
Battered by declining defense spending and a national recession, the region looks to start-ups for revitalization

BY ELIZABETH B. BAATZ

In January 1990, Ted Eaton fell victim to the recession. Laid off from his position as New England sales director for Prime Computer Inc. in Natick, Mass., 47-year-old Eaton was left to cope with a hefty mortgage, two children who he did not want to move to another school system, and competition from hundreds of qualified high-tech salespeople in the same predicament. And because of the highly specialized nature of his field, "it seems that unless you're experienced in a specific product, are five feet nine inches tall, and have blue eyes, no one wants you," he says with a grimace.

Eaton is just one of thousands of New Englanders who have been hit especially hard by the recession. The region not only is struggling with the downturn in the national economy, but also had been wrestling with sweeping changes long before the recession made the news last summer. For companies around "America's Technology Highway"—the Route 128 loop—the ride has become rougher than anyone had expected: By this past winter, nearly 1 of every 10 Bay State workers were unemployed, giving Massachusetts one of the nation's highest jobless rates.

New England has been a sort of lightening rod in the current downturn, explains economist Edward Moscovitch of Cape Ann Economics in Rockport, Mass. The main reason: a fundamental restructuring of the regional economy because of the virtual disappearance of defense and minicomputers as the most powerful drivers of economic growth.


Down and out in New England electronics

American Electronics Association; *1990 estimate by ELECTRONIC BUSINESS

"This recession has been devastating," says Barry Bograd, a human-resources consultant with Erdlen-Bograd Group Inc. in Wellesley, Mass. "Now engineers have adjusted their expectations. They are thinking, 'I'll take anything, I'll go anywhere.' "

Military matters

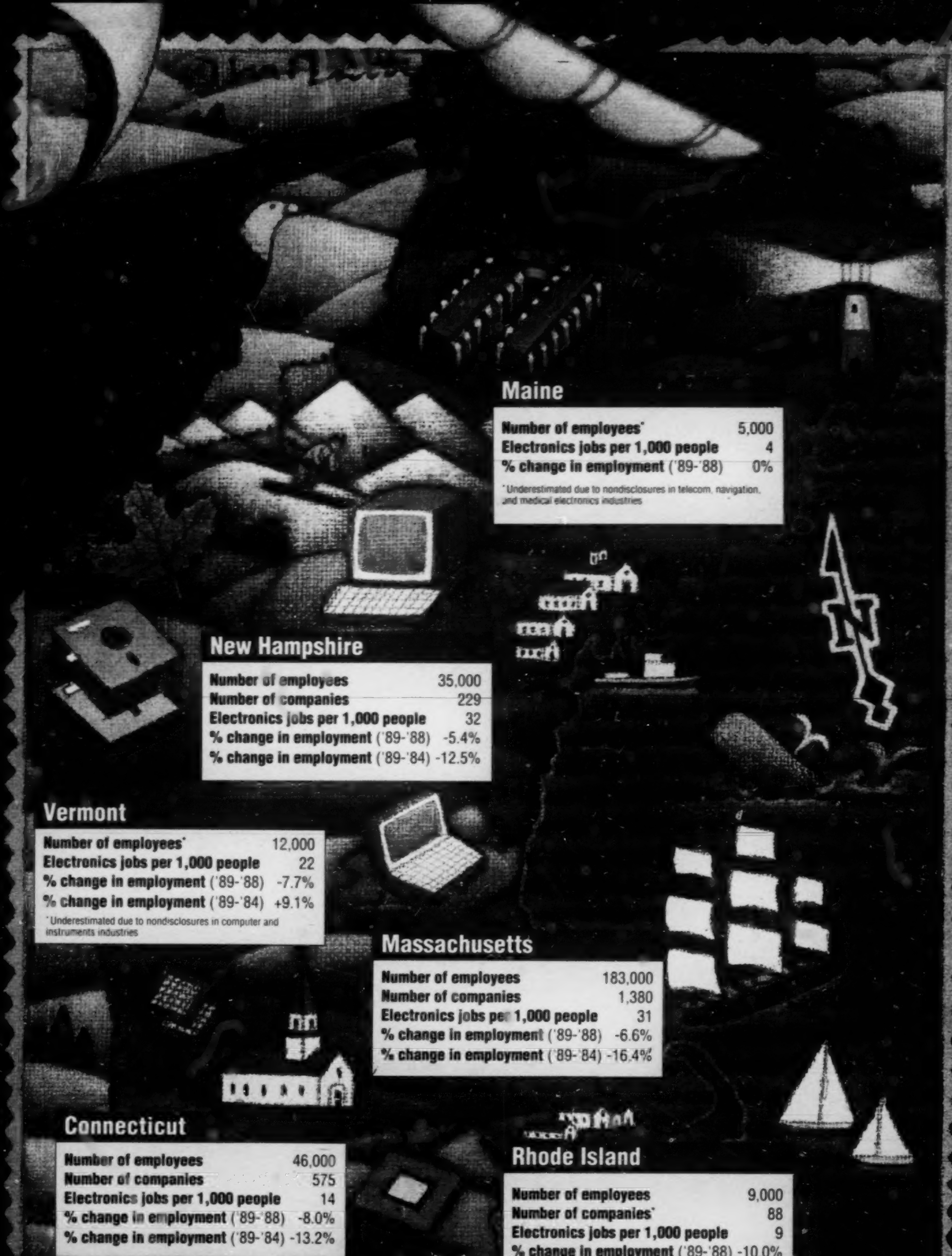
For giant defense contractors such as Raytheon, Lockheed Sanders, General Dynamics, and United Technologies, the problem isn't New England—it's Washington D.C. and the declining defense budget. While defense electronics will fare better than the rest of the defense procurement budget, it may never again see the easy-money, double-digit-growth days of the Reagan administration. Nor will the defense research, development, test, and evaluation budget—which drives the funding for many programs at the Massachusetts Institute of Technology in Cambridge and many companies in the state—rebound quickly from the Reagan heydays.

New England's dependence on military spending created jobs and growth throughout much of the 1980s. Between 1987 and 1989, Massachusetts received an average $1,405 per resident and Connecticut received $1,651 per resident in prime-contract awards—roughly three times the national average of $514 per capita, according to Yolanda K. Henderson, an economist with the Federal Reserve Bank of Boston. Last year, however, prime-contract awards to New England fell by 8%, and no end to the decline is in sight.

But New England defense contractors are fighting back. According to a survey of 355 defense companies in the region conducted last year by the Bank of Boston, more than three-quarters of the contractors have been adapting to the new environment by developing new lines of businesses, increasing marketing efforts to non-defense prospects, exploiting foreign markets, and exploring acquisitions or joint ventures to move into new businesses.

Profits will be elusive in this new, more competitive marketplace. While the Persian Gulf war meant extra business for Lockheed Sanders Inc. in Nashua, N.H. (the leading producer of aircraft radar jammers), the company is still staring down the barrel of fewer military contracts in the future. Lockheed Sanders's response has been to reduce the work force by 1,200 in 1990 and pare overhead across the board. "We began two years ago to position ourselves in order to compete in this tougher, more competitive environment," says company spokesman Marvin Braman. Adapting also meant refocusing product lines on those areas that Lockheed Sanders thinks will be more successful—avionics and anti-submarine warfare systems.

A few years ago, perhaps, many of



Maine

Number of employees*	5,000
Electronics jobs per 1,000 people	4
% change in employment ('89-'88)	0%

[*] Underestimated due to nondisclosures in telecom, navigation, and medical electronics industries

New Hampshire

Number of employees	35,000
Number of companies	229
Electronics jobs per 1,000 people	32
% change in employment ('89-'88)	-5.4%
% change in employment ('89-'84)	-12.5%

Vermont

Number of employees*	12,000
Electronics jobs per 1,000 people	22
% change in employment ('89-'88)	-7.7%
% change in employment ('89-'84)	+9.1%

[*] Underestimated due to nondisclosures in computer and instruments industries

Massachusetts

Number of employees	183,000
Number of companies	1,380
Electronics jobs per 1,000 people	31
% change in employment ('89-'88)	-6.6%
% change in employment ('89-'84)	-16.4%

Connecticut

Number of employees	46,000
Number of companies	575
Electronics jobs per 1,000 people	14
% change in employment ('89-'88)	-8.0%
% change in employment ('89-'84)	-13.2%

Rhode Island

Number of employees	9,000
Number of companies*	88
Electronics jobs per 1,000 people	9
% change in employment ('89-'88)	-10.0%
% change in employment ('89-'84)	-18.2%

[*] Source: RI Dept. of Economic Development

Source: American Electronics Association - All data for 19

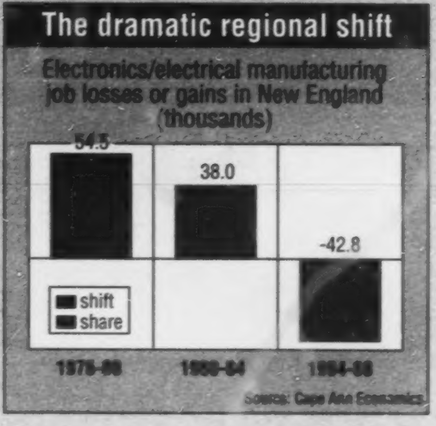
Latta McEntire

How the miracle disappeared

There are two ways for a region to grow jobs. One is to have the right mix of growth industries and to grow those markets at the same rate as the rest of the nation. The other is to attract jobs and industries from other regions.

In the 1970s and early 1980s, New England did both well. The chart below shows the region gained nearly 55,000 jobs in the electronic and electrical equipment industries from 1975 to 1980, and 38,000 jobs from 1980 to 1984. Many of those jobs (31% in the '70s and 71% in the early '80s) were gained by shifting jobs from other regions in the U.S.

But in the mid-'80s things changed. In four short years (from 1984 to 1988) New England lost almost 43,000 jobs, with 65% of those leaving to go to other regions. ☐


The dramatic regional shift

Source: Cape Ann Economics

the unemployed defense engineers and salespeople could have made a successful transition to the minicomputer market, New England's largest commercial-electronics sector. Those companies sneaked past IBM in the late 1970s and early 1980s, and their success was one reason for the highly lauded "Massachusetts Miracle." But when West Coast PC and workstation companies executed their end run past the minicomputer in the mid-1980s, the miracle started to evaporate.

Today, most of the New England mini companies are known largely for their financial woes. Wang let over 3,000 people go in Massachusetts alone during the last two years. Data General left 600 Bay State citizens in the unemployment lines, Prime Computer almost 3,000, and Digital Equipment nearly 6,000 worldwide.

Despite these numbers, many New England business observers are surprisingly optimistic about the region's future. The severity of the downturn has been "overstated" by journalists who lack historical perspective, argues James M. Howell of The Howell Group in Boston. "They weren't here to see the regional recession in the '70s or the serious structural adjustments that took place here after World War II."

New England business leaders also take hope in their new governors, who are generally more pro-business than their predecessors. Massachusetts has been dealt an especially brutal blow by four solid years of spending deficits and three straight years of tax hikes. The result—not only in Massachusetts but also in neighboring states struggling with their own budget crises—has been a huge loss in business confidence.

When West Coast PC companies executed their end-run, the miracle evaporated

The changing of the guard has made some electronics executives more optimistic about their chances for survival and success. For the past two years, the Massachusetts High Technology Council's survey of Bay State companies showed that only 2% of high-tech executives expected improvement in the business climate; with pro-business governor William Weld now in office, the latest survey shows that 8% expect improvement.

Betting on pro-business state governments may be surer now than in the past. New Hampshire is trying to make doing business in the Granite State easier. "All the New Hampshire agencies that affect new business get together once a month now," says Bill Herman of the Department of Resources and Economic Development. "We've set up a network to try to get prospects through the system and solve problems more quickly."

Dan Daily, the new undersecretary of economic affairs for Massachusetts, is taking a pro-business message to the community too. "We're going out to the business community and saying that you are important because you control jobs," he says.

New England start-ups

"The factors that led to the minicomputer start-ups here in the late 1970s are still here," says economist Moscovitch. And New England's electronics start-ups are as vibrant and as active as ever. "We have incredible intellectual assets of well-trained workers and the infrastructure of lawyers, accountants, bankers, and suppliers who understand high-tech business," says Moscovitch.

Even small-business leaders who are struggling with the recession have an innate optimism about their home. Bob Forsberg, CEO of contract-manufacturing company Mutron Corp. of Brockton, Mass., and chairman of the New England Council of the American Electronics Association, laughs at the suggestion that the end of the Gulf war and the nationwide recession will mean the end to New England's economic troubles. "But New England is still a world-class place to live and a world-class place to own a business," says Forsberg.

First-rate universities such as MIT continue to generate a new breed of businesses that locate in New England. "I don't believe that a lot of things people measure—such as the tax rate, cost of housing, or cost of money—are big factors here," says Bernard Gordon, founder and CEO of Analogic Corp. in Peabody, Mass. "Look at Silicon Valley. It costs an awful lot to live there, but businesses are still starting there."

A story about Stardent Computer Inc. of Concord, Mass., illustrates the attractiveness and strengths of the region. Stardent was the result of a merger between a Bay State company and a Silicon Valley company. The president, John William Poduska, and a majority of the executives lived

A hopeful future: Four New England companies that shine

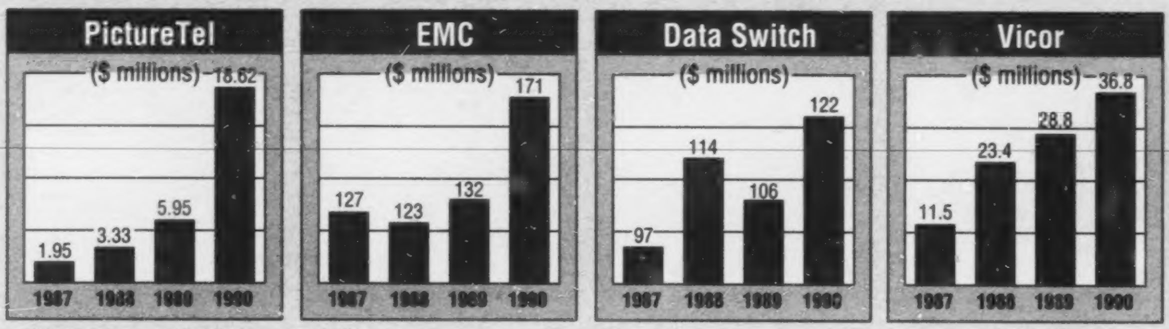
The future for electronics in New England isn't as bleak as the layoff notices in the local newspapers might suggest. In fact, many small start-up companies—particularly in communications, medical instruments, and technical software—did exceptionally well last year despite the recession.

PictureTel Corp. began as a result of HDTV research at MIT. Since its founding in 1984, this Peabody, Mass., company has become the world leader in videoconferencing. The company has doubled or tripled its revenue every year since 1987. Norman E. Gaut, president and CEO, expects the $18.6 billion company to have near 60% growth again in 1991.

EMC Corp., a manufacturer of computer storage products in Hopkinton, Mass., had been doubling revenue every year for eight years in a row until 1987. After the first loss in the company's history in 1988, EMC was forced to reexamine their entire production process. With the help of Conway Quality Inc.'s Continuous Improvement program and a new VP of quality assurance, the company grew revenue 30% to $171 million in 1990.

Data Switch Corp. has been a member of the Shelton, Conn., community since 1977. This switch maker grew revenue 15% to $122 million in 1990. Like EMC, a loss in 1989 forced the company to reevaluate its quality procedures. Data Switch is targeting exports as a major source of growth in the years ahead. Exports to Europe grew 50% last year, says CEO and president Robert Gilbertson. Next stop: Asia.

Vicor Corp. has made its proprietary power systems pay off big with 28% revenue growth last year. Princeton University physicist Patrizio Vinciarelli was talked into starting the business in Massachusetts because, says marketing VP Richard Beede, "that's where the skilled labor was." Boston's Route 128 was a natural choice, says Beede. The $37 million company does have one problem, however: not enough space in it's Andover, Mass., parking lot. ☐



All figures are revenue for each company's fiscal year

Source: Company reports

in Massachusetts. When it came time to consolidate overhead functions, they wanted to stay in New England.

Says company spokeswoman Roxanne Frisiello, "Along with a very strong belief that this area would be fine, the executives located the Stardent headquarters here because it was easy to find the people, the engineering talent, and the companies to get things done here." So in May 1990, while the region was slipping into its most severe recession since 1972, the company announced that it was locating the headquarters in New England.

Stratus Computer followed a similar decision-making process. Back in 1980, when he was trying to decide where to base his own computer start-up, CEO Bill Foster also pitted Silicon Valley against Boston's Route 128. Foster had grown up, attended school, and had his first job with Hewlett-Packard Co. on the West Coast. Before starting Stratus, Foster was a vice president with Data General Corp. on the East Coast. By the time the decision of where to locate his company came up, his family was well settled in Massachusetts. But the location decision was primarily a business one. Back in 1980 there was simply a larger pool of systems design and software integration talent available in his adopted home state. The company landed in Marlborough, Mass.

As long as MIT, Harvard, and the rest of the regional colleges continue to attract bright minds to the region, New England will regain its old luster. Economist Howell points out that the long-term prospects are excellent, since the region has a "disproportionate" share of industries that are slated for strong growth: computers, peripherals, engineering and technical software, advanced materials, medical research and biomedical companies, and engineering, consulting, and financial services. "These industries are forecast to grow faster than others in the next decade," says Howell, "and New England has a large share of these industries."

So the corporate giants in defense electronics and minicomputers won't be the region's salvation, now or perhaps ever. Instead, the new start-ups will determine New England's future.

And whatever became of Ted Eaton? Twelve grueling months after leaving Prime, Eaton became vice president of sales and marketing for Workstation Solutions Inc., a small New Hampshire start-up. "I'm not with a traditional company any more," says Eaton, "but I got what I wanted—an opportunity to build and grow." As Eaton's new company and other small start-ups grow, New England will grow again too. ☐

Inventories: How low can they go?

Just-in-time management has taken some of the sting out of the recession. But some say a rebound could spark a new round of shortages

BY ELIZABETH B. BAATZ AND DAVE WEBB

Imagine that it's late summer and demand for your product is hot. Imagine also that because of an unexpectedly brisk economic recovery during the early summer months, your suppliers can't get their materials. Within a few months, the result is industrywide shortages that evoke memories of 1981 and 1984.

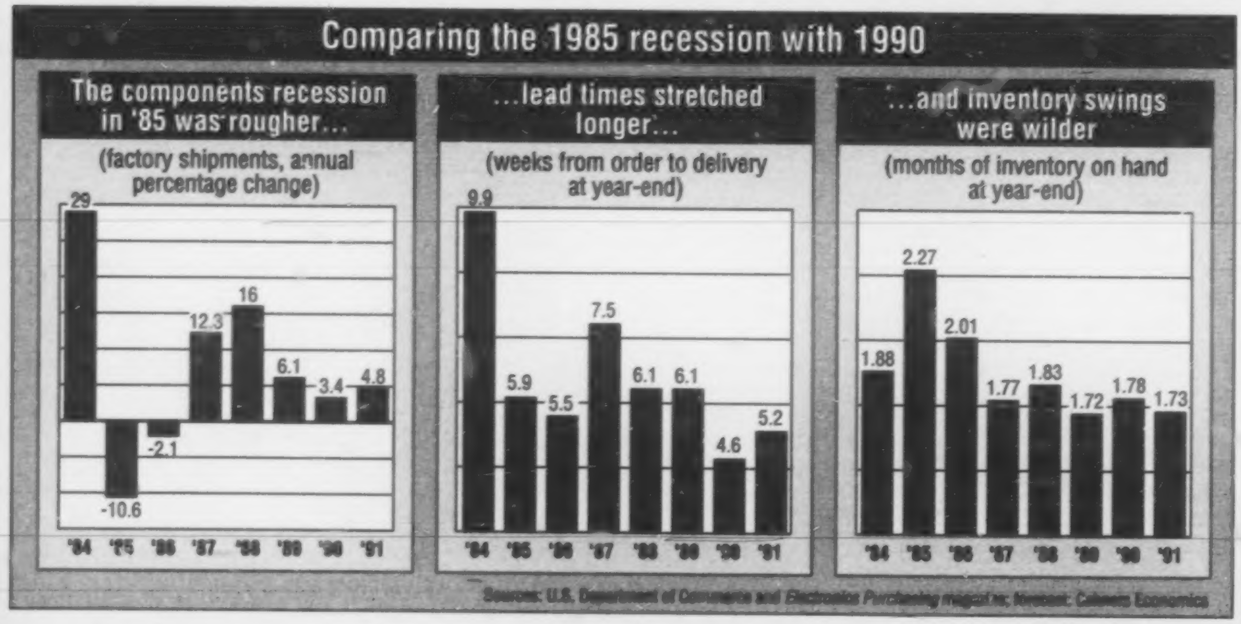
Many industry watchers think that such a scenario is not only possible but probable—if not during the coming economic recovery, then by the next one. The irony is, one of the reasons for the shortages just might be the resounding success of just-in-time inventory methods.

"As JIT becomes more prevalent, we will become dangerously prone to whiplash by the inventory cycle," warns Ralph Anavy of the Electronic Outlook Corp. in San Francisco. "Everyone will be scrounging around for product. If there is a disruption in the system, then I expect the system to break down."

Admittedly, many observers take issue with Anavy. After all, it was sophisticated inventory management during the most recent recession that prevented inventories from ballooning as they did during the recessions of the 1970s and 1980s. Because of those management skills, chip producers have cut their inventories from 39 days of supply on hand in early 1989 to 31 days by the first quarter of 1991, according to researchers at Dataquest in San Jose. Anavy adds that all component makers have cut stocks from 61 days in 1985 to 54 days in 1990.

The result has been a healthier bottom line for many companies. In 1980, for example, NCR Corp. carried over $1 billion in inventory, while revenue came in at $3.3 billion. By 1990 their inventory had fallen to $499 million, while revenue hit $6.6 billion.

But it's just this happy scenario that is giving some executives the jitters. Factory production can't turn around on a dime, particularly in capital-intensive industries such as semiconductors. And if the industry is fortunate enough to have a long, strong, and sustained recovery, it is unclear whether the inventory management practices that performed so well in the late 1980s will work in the unpredictable 1990s. "As long as overall market changes are gradual and orderly, JIT will function smashingly," says Anavy. But if market fluctuations are rapid and demand



Comparing the 1985 recession with 1990

The components recession in '85 was rougher... (factory shipments, annual percentage change)

...lead times stretched longer... (weeks from order to delivery at year-end)

...and inventory swings were wilder (months of inventory on hand at year-end)

Sources: U.S. Department of Commerce and *Electronics Purchasing* magazine; forecast: Cahners Economics change is sizable, he adds, "JIT will not perform in the United States up to expectations."

The reason, he says, is that successful JIT policies hinge largely on a tradition of supplier-user cooperation—common practice in Japan, but relatively rare in the U.S., where business relationships tend to be more adversarial.

The 25% premium

The push to trim inventories is not new, of course. Competition from Japan, shorter product life cycles, and reduced margins have focused management's attention on return on assets. Besides the cost of capital, hidden inventory costs include warehousing, maintenance, insurance, taxes, erosion of inventory, rework, and scrap.

As a result of this increased attention to costs, unwanted inventories have been largely nonexistent lately. Many component companies seemed to have anticipated the recession and adjusted their inventories as far back as 1989, says George Miller, president of a Chatsworth, Calif., consulting firm. The response by semiconductor maker Cirrus Logic Inc. typified the industry's inventory policy, especially during the Gulf crisis. "Because of uncertainty in the Gulf, we focused on our manufacturing forecast and brought inventories in," even as revenue grew, says Cirrus Logic's marketing vice president George Alexi.

The changing inventory policies of American industry has carried some unexpected benefits. In electronics, better inventory management changed the very nature of the latest industry slump. Compared with the wild gyrations in inventories in past recessions, the latest experience has been mild indeed.

More predictable inventory swings have benefited one industry segment in particular—electronics distributors—a group that has traditionally been most dramatically impacted by such fluctuations. But while distributors suffered slowdowns or minor sales losses in the past year, the pain has been nothing like the trauma of earlier sales contractions. "With so many customers having such small inventories, they could stop buying for four weeks instead of four months [to correct any inventory overhangs]," says Steven Kaufman, president and CEO of Arrow Electronics Inc. in Melville, N.Y. "So the recession impact has been much milder at the supplier and distributor level. My company hasn't seen it at all this time compared with the last recession."

A climate of JIT excellence

Despite the doom and gloom about JIT from industry analysts and consultants, many U.S. companies have made tremendous progress in the past decade.

A good example is IBM's Rochester, Minn., plant, where inventory turns have increased 60% from 1985 to 1990, according to plant manager Andy Papamarcos. One pressure that helped: an increase in manufacturing cycle times. "Back in '85, we measured cycle times in months and weeks. Now they are measured in hours," says Papamarcos.

At the Huntsville electronics division of Chrysler's Acustar Inc., meanwhile, the normal delivery window is four to eight hours, which has forced many suppliers to utilize third-party warehouses near the Atlanta plant.

"We averaged 50 to 100 shortages a week in 1985, largely because we had so much inventory that even if the material was [at the plant] we couldn't find it," says Jerry McCarty, Acustar's production control manager. "Today we might have an average of five shortages a week."

NCR's Tom Kane: "If you don't learn how to manage low inventories one step at a time, you will fail"

NCR Corp.'s statistics comparing 1980 and 1990 are impressive as well. How did they do it? They did not change their organizational structure, explains manufacturing vice president Tom Kane. "We adopted JIT by having each plant appoint a JIT champion. You cannot dictate low inventories. It's a journey—if you don't learn how to manage low inventories one step at a time, you will fail." ☐

NCR's inventories then and now

1980	1990
$1 billion in inventories on $3.3 billion in revenue	$499 million in inventories on $6.3 billion in revenue
3 inventory turns each year	12.7 inventory turns each year
400 suppliers per plant	150 suppliers, per plant with 25 providing 80% of the plant's purchases
75 days of supply on hand	17 days of supply on hand
100 items on shortage list	1 to 2 items on shortage list

Source: NCR Corp.

Lee D. Henning, vice president for the manufacturing support division of Data General Corp. in Southborough, Mass., tells a similar story from the OEM's perspective. "We came off the 1983 to 1984 period out of everything," he says. "We were selling product well in advance of the supply line. When this downturn came, we were already into cost controls, and we were much more selective about suppliers. So we did not have to modify much."

There's another industrywide benefit from better inventory management: A rebound in the economy will show up quicker in higher fac-

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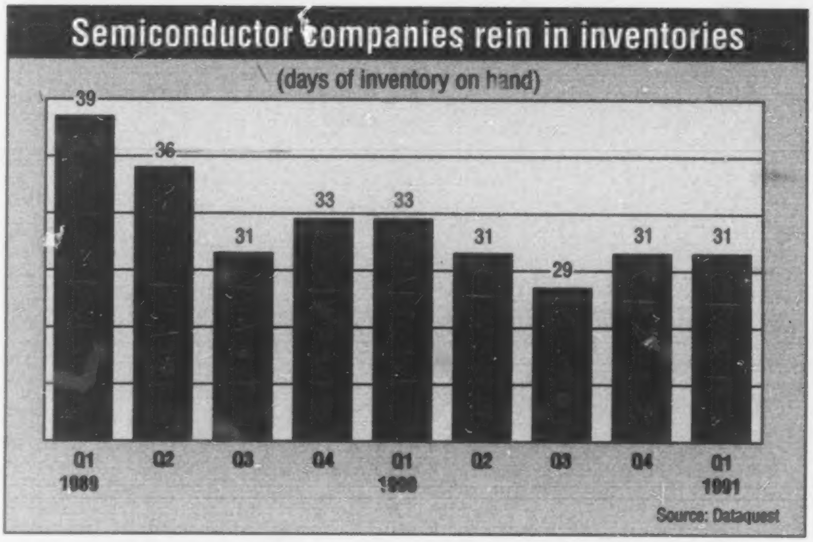
Semiconductor companies rein in inventories

(days of inventory on hand)



Source: Dataquest

tory-production rates than in previous recoveries. In the past, inventories accumulated during recessions; when the recession ended, producers satisfied customer demand—not by stepping up production, but by using up their excess stocks. Now, with little unwanted stock in the warehouse, producers will have to ramp up their plants faster when demand recovers.

The "illusion" of JIT

So what accounts for the warnings being issued by some industry observers? For one, the large number of inventory levels in the supply chain—from component suppliers to equipment manufacturers to OEMs—leaves the system vulnerable. A weak link in the chain can throw the entire system out of whack. If every link in the supply chain has drastically reduced inventories, then the risk of shortages rises.

As a result, at least one economist thinks that widespread shortages could hit the electronics industry even sooner than Anavy predicts. "It could happen this year because most people aren't yet optimistic about the current outlook," says Ed Henderson, president of Henderson Ventures in Los Altos, Calif., who predicts double-digit growth in semiconductor sales in 1991. If a significant number of companies underestimates demand as the economy emerges from the recession, he says, then there could indeed be trouble.

What makes Henderson, Anavy, and others so nervous is the suspicion that few companies are actually using JIT. "When companies say they've gone to JIT, don't believe it," says professor James Reeds, a regional education director for the American Production and Inventory Control Society Inc. in Falls Church, Va. While agreeing that manufacturing inventories are being handled better, Reeds remains skeptical about what he calls "the illusion of JIT."

Like total quality management, he says, true JIT is a journey. "It is excruciatingly slow," says Reeds. "The Japanese have 40 years of trial and error [in JIT], while we in the United States are just ending our first decade." He suggests that it could be another decade before true JIT is widely adopted in the United States.

In many cases, says Reeds, equipment makers simply hide their costs by forcing suppliers to hold their parts inventory. While that policy cuts the equipment makers' inventories, suppliers merely pass along their higher inventory costs to the customer. And if buyer-supplier partnerships are weak, or if JIT is otherwise poorly implemented, then Anavy's scenario may not be so unrealistic.

Other factors could contribute to widespread shortages in the electronics industry under the rubric of JIT. Salespeople can forecast incorrectly.

Suppliers may have the incorrect mix for capacity. Procurement personnel can inadvertently build up inventory. "Relative to four or five years ago, things are markedly improved," says senior analyst Mark Giudici with Dataquest Inc. in San Jose. "People are talking to each other, but not as much as the textbooks want. There is still room for improvement in forecasting and communication."

Many large companies claim to be unworried by the prospect of sudden shortages. "It depends on who you are in the supply chain," says Russel Craig, a vice president with Arthur D. Little in Cambridge, Mass. "Big companies have the communications systems and size to demand attention, but smaller companies that don't have the purchasing clout may have a problem."

> **In Japan, JIT policies hinge largely on a tradition of supplier-user cooperation**

NCR's Kane is optimistic about his company's abilities to manage supplies in an upturn, since NCR focuses on customer response, not on inventories. It's a cultural change that has been ongoing at NCR a number of years before the 1984 to 1985 inventory scare, says Kane. Total quality management and strategic alliances with suppliers were begun in the '80s. Now NCR is looking for continual improvement in forecasting and is investigating ways to add incremental capacity quickly.

In fact, while large companies are generally confident of their supplier relationships and their ability to avoid shortages, each is continuing to improve even more. Prior to total quality management at NCR, according to Kane, "We were in a continual expedite mode. . . When we had a lot of inventory back in 1980, I could go to any plant and see a hundred parts on the shortage list. Now I go to a plant and see just one or two parts on the shortage list." Those improvements, he says, mean that NCR will be able to respond to customers as well in an upturn as in a downturn. ☐

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Europe to liberalize satellite services market by 1992

But U.S. companies worry that they will have to fight their way into what may yet become a politically heated arena

BY LINDA BERNIER

U.S. satellite equipment manufacturers are scurrying all over Europe to consolidate their markets and cash in on the impending liberalization of Europe's communications satellite market. Their goal: to nail down an even bigger piece of the action in the European Community's $331 million satellite services market.

As that market opens over the next three years, however, some Europeans balk at the prospect of being overrun by U.S. competitors. Buoyed by military and space R&D contracts and vertically integrated activities, U.S. companies have been far more aggressive than their European or even Japanese counterparts: Until recently, U.S. manufacturers held 75% of what is now a $4.6 billion "second-generation" world satellite communications equipment market, while European manufacturers (led by France's Alcatel N.V.) held a meager 20%.

The European Commission issued its Green Paper on Satellite Communications last November and has since consulted with industry, users, and service providers in order to prepare the new laws. A framework directive is scheduled to be issued by the end of this year.

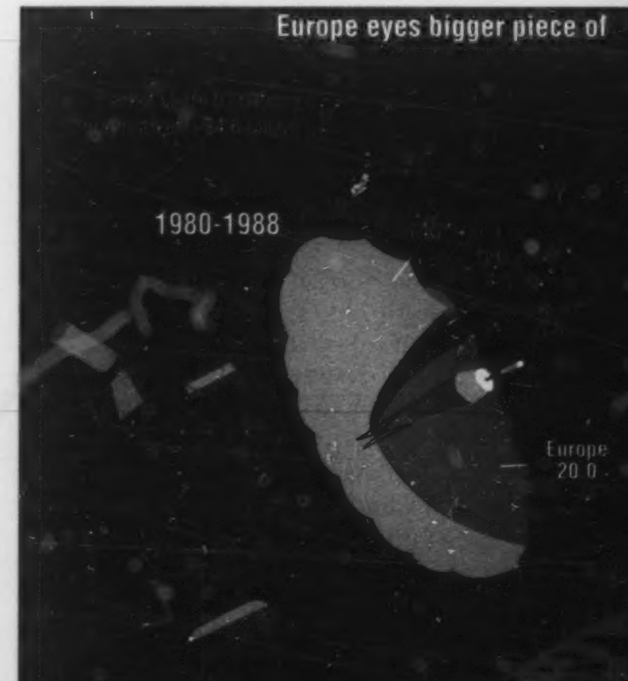
The Commission's proposals are designed to open up the earth segment (including receive-only and transmit-receive terminals), provide unrestricted access to the space-segment capacity, and allow full commercial freedom to space-segment providers—including direct marketing of satellite capacity to service providers. These markets now fall under the highly restrictive control of most European national operators (the "PTTs"). Along with European equipment makers, the PTTs are fighting hard to protect their turf.

But U.S. manufacturers are just as determined to push deeper into the market. Over the next 18 months, for example, industry leader Hughes Network Systems Inc. hopes for an eight-fold increase in its European sales of very small aperture terminals or VSATs—the small, two-way satellite units suited for business use. AT&T Tridom is courting PTTs all over Europe and identifying potential customer network clients. "We're up to our gunwales trying to win some of the requests for proposals for VSAT equipment," says Jon Collins, AT&T Tridom's European marketing director. Hughes may be market leader, he says, but "we're certainly not going to lie dead."

The Commission predicts that the worldwide satellite revenues will rise to only 1.5% to 2.5% of total telecommunications services by the year 2000, versus the current 0.4%. But the Commission also figures that by opening up the highly fragmented European market, economies of scale will slash the cost of a commercial satellite by up to 40%. Policy makers also hope that liberalization will boost new satellite business services—particularly in the financial, manufacturing, and retail sectors, which today account for only 10% of all European satellite services.

More U.S. domination?

But many Europeans see most of the benefits of liberalization accruing to non-European companies. "If you open the market tomorrow, it will be completely dominated by U.S. suppliers and operators," says Jacques Blanche, a director at Alcatel and chairman of the regulatory affairs


Europe eyes bigger piece of

group of the European Telecommunications and Professional Electronics Industry. Blanche wants the EC and other government institutions to provide increased R&D funding and programs to European satellite communications manufacturers so they can compete more effectively against U.S. companies. "It's too late for the first-generation products, but it's not too late for the second-generation products," he says.

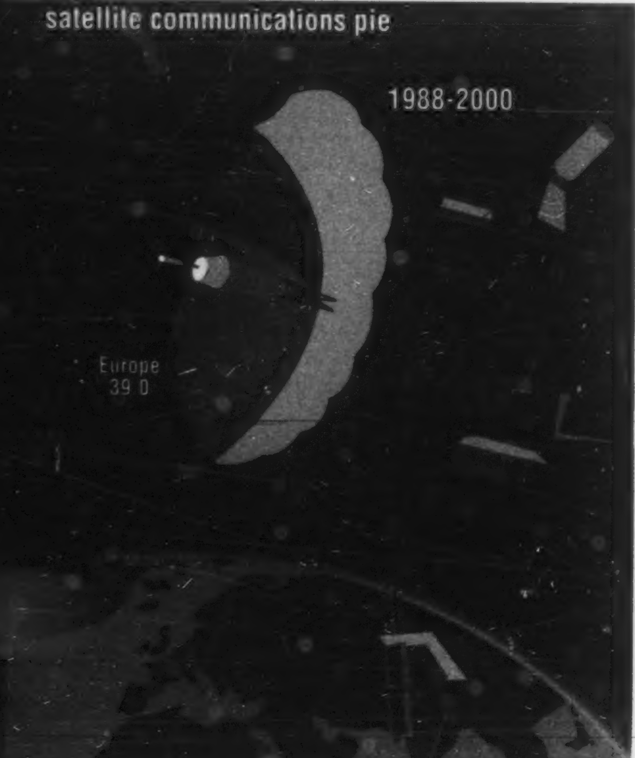
Some U.S. executives, fearful of ruffling European feathers, are keeping a very low profile in the debate. "We don't want to get involved in politics," says one.

Others are not so shy. Andrew Werth, president of Hughes Network Systems, Europe's major VSAT supplier, doesn't think taking $60 million a year worth of Europe's available VSAT business justifies protectionism. "It's not our ambition to steal all of [Europe's] business," he says. "We have made major investments in our products and we want to sell them." He thinks that if liberalization takes off, the European VSAT market could grow from about 10,000 today to about 40,000 over the next five years.

To better position itself, HNS has forged distribution and maintenance alliances with Germany's Dornier GmbH and Selenia-Spazio SpA of Italy. AT&T Tridom expanded last year's distribution agreement with France's Matra Espace to allow it to manufacture, assemble, and test its technology in Europe, bringing local content up to 30% or 40%. AT&T Tridom has also established a distribution agreement with the German telecommunications equipment maker, Fuba A.G.

A gradual opening

European companies, meanwhile, are not standing idly by. Both British Aerospace plc and Daimler Benz A.G. are involved in satellite systems and are increasing their vertical integration. British Aerospace established British Aerospace Communications Ltd. as a satellite service operator two years ago, for example, and the parent company has since set up ventures in TV broadcasting and business TV. Daimler Benz Interservices A.G. also was created two years ago to provide satellite communications services and act as an operator as Germany deregulates its satellite services market.



Still, liberalization won't be easy. European PTTs—particularly in France, Spain, and Italy—are expected to fight attempts to quickly open up Eutelsat (the European satellite organization) to direct access by users. Access is now controlled by the 28-member PTTs who finance Eutelsat.

Luc Perrouin, responsible for European affairs in France Telecom, says the French operator doesn't oppose gradually opening up Eutelsat sometime in the future. But, he says, it's unfair to allow users who haven't invested in Eutelsat to reap its benefits. "We want to preserve this costly investment," he says, noting that France Telecom has invested more than $396 million in satellites. Providing direct access right now also might jeopardize Eutelsat's fragile existence by prompting some members to leave for less costly suppliers, he adds. Eutelsat turned profitable only last year, after six years of operation.

Eutelsat itself also favors a gradual approach to direct access. Eutelsat now advocates providing user access through its members, meaning members could authorize users to deal directly with Eutelsat or set up offices separate from their own commercial activities, suggests Birgitta Naeslund, executive assistant to Eutelsat director-general Jean Grenier.

U.S. companies also worry that European countries might set discriminatory equipment standards, which could place financial burdens on competitors. The planned directive thus will call for mutual recognition of type approval for satellite communications terminal equipment, licenses for satellite terminal networks, strengthened frequency coordination, definition of open network provisions concerning the connection of satellite terminal networks, and harmonization of identified future transmission techniques for satellite broadcasting to the general public.

Today, national restrictions are a regulatory nightmare. British satellite service provider SIS Link Ltd. can uplink directly to the United States from Germany, for example, but not from Britain. And in France SIS Link must buy terminal equipment from France Telecom instead of providing it to the customer directly, explains Nicholas Thorley, the company's managing director.

But there are signs that liberalization of the telecommunications market is already underway, led by both Britain and Germany. Other governments generally support the Commission's proposals. HNS's Werth is optimistic about the future and looking forward to a plethora of transborder VSAT networks. After all, he says, "three or four years ago, who would have guessed that the [German PTT] would be leading the charge on liberalization?" ☐

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Wireless LANs broadcast their benefits over cable

Questions remain about cost, performance, and interference, but new market entrants NCR and Motorola help legitimize the field

BY DWIGHT B. DAVIS

More than a decade ago, Xerox Corp. researchers branded a promising data communications development "Ethernet." As a product backed by Xerox, Digital Equipment Corp., and Intel Corp., Ethernet was destined to set the pace for the emerging marketplace of local-area networking.

But Ethernet didn't really deliver on the ethereal promise of its name, nor did any competing LAN implementations. All the LANs were decidedly earthbound, dependent upon thousands of feet of snaking copper or fiber cable to deliver their messages.

The cable did the job, but installing it in some offices proved a nightmare. Then, once the cable was in place, the LAN configuration was essentially hard-wired; moving workstations or expanding the network could require more cabling expense and further office disruption.

Wireless networks, by contrast, offer the promise of easy installation and simple network reconfiguration. Most can operate independently or can piggyback on existing cable-based LANs. Wireless technologies do have their liabilities—questions of cost, performance, and signal interference have slowed market acceptance. But the recent arrival of products from Motorola and NCR are seen by many observers as a sign that the message of wireless benefits will finally get through.

Cutting cable's grip

Cable's monopoly began to unravel in the late 1980s when pioneering companies such as Photonics Corp. (Campbell, Calif.), O'Neill Communications Inc. (Princeton, N.J.), and Telesystems SLW Inc. (Don Mills, Ontario) brought wireless datacom products to market. The products, which used either infrared light or UHF radio waves to transmit information, found some ready buyers. But the wireless LANs ranged in speed from 19.2 kilobits per second to about 250 Kbps—much slower than established LANs such as Ethernet (10 megabits per second) and Token Ring (4 Mbps or 16 Mbps). In addition, the products' vendors weren't exactly household names.

"We spent about a year developing a wireless product, but then we got out of the business," says Michael Plotnick, president of T/BD Associates in Princeton, N.J., now a consulting firm. "We found that the time wasn't yet right for a small start-up company in this market."

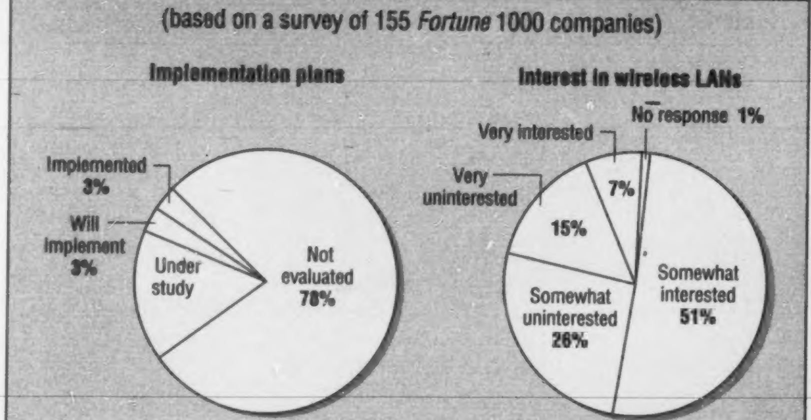
The scenario began to change last September when NCR in Dayton, Ohio, introduced its 2-Mbps WaveLAN product. Shortly thereafter, Motorola in Arlington Heights, Ill. demonstrated its wireless in-building network technology. The first product based on this technology—the 10-Mbps Ethernet-compliant Altair network—debuted in February.

A third new arrival, BICC Communications—an operating company within BICC Technologies Inc. of Westborough, Mass.—has unveiled a wireless LAN that supports 4-Mbps and 16-Mbps Token-Ring operation. BICC's InfraLAN product is based on technology the company acquired last year from a research group called UnTied Telecom.

These companies bring name-recognition and financial resources to the wireless LAN business. Each employs a distinct wireless technology (see "High-speed wireless LANs"), but all have proven that wireless products can match the speeds of the most popular cable-based LANs.

What these and the other wireless LAN vendors have yet to prove is the market potential of their products. Most believe the prospects are

Prospects for wireless LANs



Source: Business Research Group

bright. "We made our 1991 sales goals in the first six weeks after the InfraLAN introduction," says Michael J. Noonan, executive vice president at BICC Communications. He predicts that within three to five years, 25% of Ethernet and Token-Ring sales will be wireless products.

Others aren't so sure. In a survey of 155 *Fortune* 1000 information system executives, the Business Research Group in Newton, Mass., found that 78% had not yet evaluated wireless LANs as a networking option (see "Prospects for wireless LANs"). The market research firm also noted various drawbacks associated with wireless technologies and predicted that the market for wireless LANs would not exceed 7% of the total LAN market. "Although wireless LANs have many practical advantages, they will prove to be only niche products," stated BRG's survey report. "The vision of a wireless office has as much chance as a paperless office."

Wireless barriers

One of the barriers wireless LANs must overcome, according to BRG, is their high price relative to wire-based networks. But the wireless vendors believe their products already compare favorably to traditional LANs. Cost comparisons, the vendors argue, must consider the networks' lifetime costs, not just the initial purchase prices.

The distinction is important, since the key selling point for wireless products is the flexibility they permit in making LAN workstation adds, drops, and moves. Making such configuration changes with wire-based LANs can involve expensive, if not impossible, rewiring.

The experience of Travelers Insurance in Hartford, Conn., a beta site for BICC's InfraLAN, bears out the potential cost benefits of wireless installations. Travelers standardized on Token-Ring networking and went with the BICC product because it provided a seamless link to its existing cable-based LANs, says Nick Blazensky, a Travelers director and manager of site design.

Putting LAN cabling in new office space at Travelers cost only $300 to $350 per station, but the cost ran from $500 to $1,100 per node if the wiring had to go into office space that was already occupied. In the latter cases, drilling holes, pulling cable, and testing had to occur during off hours, and labor costs skyrocketed. The latter case was typical at Travelers', whose targeted LAN installations were at its existing field offices.

BICC's InfraLAN units cost $2,995 each, but each can support up to six users. At $500 per user, InfraLAN's best-case, up-front costs compare favorably to the wired LAN solutions. In addition, the products can be installed by the users themselves without major office disruptions—an important benefit as LAN configurations evolve. "We move about 30% of our installed base each year," says Blazensky, "so ease of installation is a big factor."

Performance specs

With the introduction of the NCR, Motorola, and BICC products, the skepticism about the speed potential of wireless technologies has started to evaporate. Indeed, Motorola—which uses low-power, 18-gigahertz (GHz) radio as its transmission medium—can scale its technology to support 80-Mbps to 100-Mbps speeds, says Mil Ovan, senior marketing manager for Motorola's Altair network.

BICC's point-to-point infrared technology could also support such rates, claims Noonan. Even NCR's wireless technology—based on so-called "spread spectrum" radio transmissions in the 902-megahertz to 928-MHz bandwidth—has much higher speed potential, says Daryl R. Maddox, senior product manager within NCR's Financial Systems Division. "Many say spread spectrum can't go much faster, but we use only half of the available bandwidth. In the upper bands, we're looking at running at up to 40 Mbps."

With wireless LANs, though, speed is not the only performance issue. Depending upon the transmission technology employed, the networks can be susceptible to interference or to outright blocking of the signals.

Infrared transmissions are immune to interference from outside electromagnetic sources but can be physically blocked by walls, ceilings, floors, and people. As such, infrared is commonly perceived to be most suitable for open office environments where transceivers can transmit directly to one another or can bounce transmissions off a common ceiling

High-speed wireless LANs

Company/Product: Motorola Altair
Technology: 18-GHz radio, 25 milliwatts power
Speed: 10 Mbps (Ethernet compliant)
Product benefits: Closed office operation; licensed spectrum free from external interference
Product liabilities: Licensing required; uses external radio units; unanticipated radio propagation could interfere with nearby Altair microcells
Costs: Control module (one per microcell) — $3,995; User module (supports up to six users) — $3,495

Company/Product: NCR WaveLAN
Technology: Spread spectrum in 902- to 928-MHz band, under 1 watt power
Speed: 2 Mbps*
Product benefits: Closed office operation; configured as integral PC card; no licensing required
Product liabilities: Must share band with other unlicensed devices, raising interference concerns; not Ethernet or Token-Ring compliant (but is compatible)
Costs: Network interface card (one per user) — $1,390

Company/Product: BICC InfraLAN
Technology: Point-to-point infrared LEDs
Speed: 4 or 16 Mbps (Token-Ring compliant)
Product benefits: Immune to electromagnetic interference; signals don't propagate through walls; familiar to users of remote control devices; no licensing required
Product liabilities: Requires wiring or wall apertures to penetrate closed offices; uses external infrared units.
Costs: Base unit (supports up to six users) — $2,995

*NCR claims WaveLAN's 2-Mbps maximum data rate is roughly equivalent to the achievable maximum rates of Ethernet and Token-Ring LANs (rather than their theoretical maximums). ☐

or wall. For linking closed office stations to the networks, users can run a wire through the wall to a transceiver mounted in the open office space, or they can cut apertures in the walls through which the beams are able to pass.

Radio transmissions, unlike infrared, can pass through office walls, and systems employing either spread spectrum or higher-frequency radio waves can therefore serve easily in closed as well as open office spaces. "But going through walls can be an advantage or a disadvantage," says Gary Hughes, chief executive officer of Photonics, an infrared systems supplier. Adjacent radio networks can potentially interfere with each other, he notes.

Motorola avoids such interference, says Ovan, by operating in a band that requires FCC licensing. With two licensed frequencies for each site, Motorola is able to set up discrete "microcells," with adjacent cells using different transmission frequencies. But radio waves can travel unanticipated distances depending upon the number and the composition of the barriers through which they pass, making it difficult to predict the exact area covered by each microcell, skeptics warn.

Motorola's licensed approach does have the advantage of ensuring that its Altair networks are the only systems transmitting at their assigned frequencies. Spread spectrum, by contrast, shares unlicensed Industrial, Scientific, Medical (ISM) radio bands that can be populated by other emitting equipment.

New technologies help wireless LANs compete against cable-based systems

However, concerns about ISM interference are overrated, according to NCR's Maddox, who claims the bands "are among the quietest of all bands available." Exterior noise can occur, he admits, especially from devices such as radio location systems, which can interfere with spread spectrum networks blocks away. But WaveLAN is designed to overcome such interference and has the advantage of not requiring an FCC license, he says.

Technical debates aside, the wireless LANs must overcome one other obstacle in their quest for market share: users' health concerns. Although the networks all operate at powers and frequencies thought to be harmless to humans, "there seems to be a general, low-level paranoia about these systems," says Kevin O'Neil, vice president of network research and consulting at BRG.

In this regard, infrared technology—familiar to everyone who owns a remote control TV unit—may have a marketing advantage. "There's no argument that infrared is as safe as a church," says Hughes at Photonics. ☐

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The accelerating market for auto sensor devices

Sales soar, but bringing advanced technology to the auto industry still takes time, with no guarantee of quick payoffs to suppliers

BY JOHN PARKER AND XIONG XIAOGE

Climb behind the wheel of a $60,000 Corvette ZR-1 and scan the electronic dashboard, which happens to be one of its sexiest selling points. Sensors throughout the vehicle will tell you, among other things, the outside air temperature and the car's current gas mileage.

Even a modest sedan boasts sensors that monitor engine performance. Emerging sensor requirements—created by such features as air bags and antilock braking systems, or ABS—have revved up the staid development cycle of auto electronics technology. Take an imaginary drive into the technological future, and you may find sensors that first warn you of an oncoming tractor-trailer then automatically apply the brakes and steer you out of harm's way.

All this makes a case for cracking the auto sensor market, but experts urge caution. Small high-tech companies now supplying sensors for other applications need to know that the automotive market is different: High volume—in the hundreds of thousands of units—and low cost are the watchwords, and a systems-oriented partner with deep pockets is a valuable ally in approaching major auto makers.

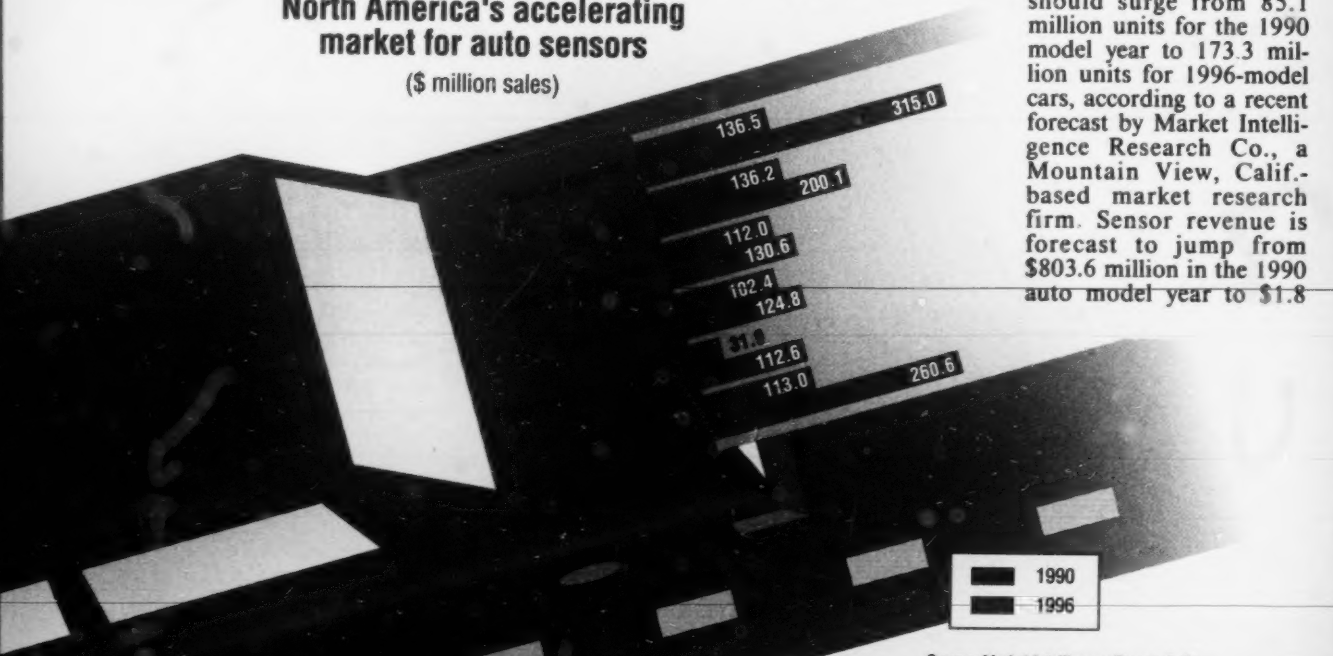
Although automotive sensors are still relatively new on the scene, the growth of the industry is remarkable and tracks the general "digitization" of the automobile. The all-brawn-and-no-brains car of the early 1970s had less than $25 worth of sensors, microprocessors, and diodes on board. By 1995 the average Ford will carry $900 worth of non-entertainment electronic components, according to Michael McGrath, managing director of Pittiglio, Rabin, Todd & McGrath (PRTM), a Weston, Mass., consulting firm for electronics manufacturers. Sensors will account for about 20% of that.

Much of the demand comes from government requirements for improved emissions control, fuel economy, and crash protection. California will soon require on-board diagnostic systems, for example, and the rest of the nation is expected to follow.

As a result, the North American market for automotive sensors should surge from 85.1 million units for the 1990 model year to 173.3 million units for 1996-model cars, according to a recent forecast by Market Intelligence Research Co., a Mountain View, Calif.-based market research firm. Sensor revenue is forecast to jump from $803.6 million in the 1990 auto model year to $1.8

North America's accelerating market for auto sensors

($ million sales)



Source: Market Intelligence Research Co.

billion in 1996, posting a compounded annual growth rate of 14.4%.

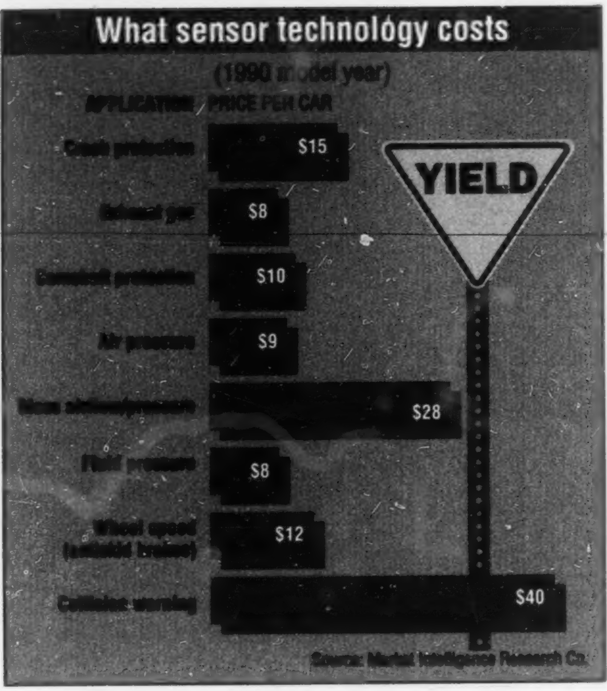
Choosing partners

Areas of anticipated growth in the 1990s include motion and position sensors, pressure sensors, and accelerometers, particularly those used in air-bag systems and ABS. To exploit those high-growth areas, sensor manufacturers may have to choose partners among automobile and auto electronics companies. "It's important for the sensor makers to seek joint activities with the auto makers in design, R&D, customer-funded research, development, or joint ventures," says McGrath. Moreover, suppliers can expect a three-to-five-year wait before finally getting the go-ahead to start mass-producing a new chip-based sensor, McGrath explains, "so a partnership with the auto maker will lessen some pain and help secure the order."

An example of such a partnership is last year's acquisition of NovaSensor—a Fremont, Calif., sensor manufacturer with about $8 million in sales—by $3.5 billion Lucas Industries plc of Birmingham, England. An innovator in silicon-based pressure and acceleration sensors, five-year-old NovaSensor primarily supplied the medical and industrial markets. The company had developed sensors-on-a-chip to measure pressure, acceleration, force, and flow using its own bonding process and was poised to attack the automotive market.

But like other small manufacturers, NovaSensor faced major hurdles. "It's tough to go to a big Detroit auto maker with a chip," remarks NovaSensor marketing manager Gary Winzeler. "They don't buy a wheel, they buy a wheel *assembly*," he says. "And when they buy sensors, they buy *systems*." Like other manufacturers assaulting the automotive market, NovaSensor also had to face the realities of producing components in huge volumes at low cost.

Although the trend toward greater on-board computer intelligence argues for the use of components with what Winzeler calls "smart functions," analysts say major auto makers are not necessarily eager to push new products. Having invested heavily themselves in older and nontransferable technology, say analysts, they may want to slow the market for newer products until they are ready to produce those products themselves.



What sensor technology costs

(1990 model year)

Source: Market Intelligence Research Co.

In NovaSensor's case, the answer was systems house Lucas, which was shopping for a leader in auto sensor technology, especially for ABS and air-bag systems, according to San Francisco marketing consultant Roger Grace. Lucas picked up all outstanding shares of NovaSensor for an undisclosed sum, says Grace, and provided the Silicon Valley company with immediate access to systems-engineering capability and more clout with auto makers. At the same time, Lucas allowed NovaSensor to enter R&D alliances with other automotive electronics suppliers.

The deal with Lucas prompted NovaSensor executive vice president Janusz Bryzek to proclaim that "we expect to become a world-leading supplier of automotive pressure and acceleration sensors within three years." At present, though, it's too soon to talk market share. Sales of auto sensors will account for only a portion of the company's expected $14 million revenue in 1991. "They have a number of R&D contracts," says consultant Grace. "But in this business it takes years" to establish a strong market presence.

In fact, market-share figures overall are hard to come by in the field of auto sensors. The newer technologies haven't yet produced measurable sales, and analysts agree that many companies working in those technologies are keeping quiet to avoid alerting competitors. Some major auto makers, including Ford, manufacture sensor devices in-house. The role of auto makers' captive suppliers (such as General Motors supplier Delco Electronics Corp.) further cloud the picture.

But it's clear that the auto sensor market has attracted electronics heavy-hitters. In Phoenix, for example, Motorola Inc.'s automotive products division has shipped more than 10 million sensor units for auto applications over the past three years, supplying both to auto makers and auto electronics suppliers. The company manufactures manifold air-pressure (MAP) sensors and is investing millions in research and development of accelerometers, according to automotive strategic marketing manager Bill Van Tine.

Technology shift

While industry experts agree the auto sensor market is due for strong growth, the pace of technological change may be slower. "The industry is ready for something new," says Paul Hansen, editor and publisher of *The Hansen Report on Automotive Electronics*, published in Goffstown, N.H. "The problem is that to bring new technology to the market takes years and years" because of price and supply concerns. "In the automotive industry," says Hansen, "proven technology is where it's at."

Present sensor systems do tend to rely on tried-and-true electromechanical technology. However, there's growing attention to the applicability and potential of solid-state devices. In a typical air-bag system, as many as five accelerometers are installed at the front of the vehicle as crash sensors, with an arming sensor in the driver's compartment to prevent the bag from inflating accidentally. In a collision, the effects of rapid deceleration elicit an electrical signal from the crash sensors. If the electrical current exceeds a predetermined level, it ignites the propellant that inflates the bag.

Then there is the ABS system, relying on sensors that track the speed of each wheel. Add to the list the fluid-level sensors that monitor engine oil and the airflow and engine-speed sensors that track engine performance. As engineers tie all these sensors together, say experts, precise, instant, and direct measurement becomes more and more important.

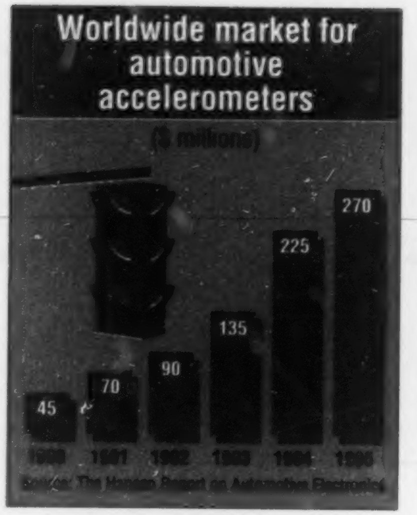
A case in point is the development of mass airflow sensors. The prevalent MAP sensors respond indirectly by inferring airflow from changes in the behavior of the manifold. Hansen says the non-mechanical mass airflow sensors provide a more accurate direct measurement.

"Emissions control will work much better if you can directly sense how much air is coming into the engine," says Hansen. In addition to the use of micromachined silicon, thin-film and hot-wire sensor technologies may be the key to volume production of mass airflow sensors that will unseat the reigning MAP products, he speculates.

But according to Joe Staller, operations manager for Motorola's semiconductor products sector's sensor business, mass airflow sensors are nearly twice as expensive as MAP sensors. As a result, sensor-development partner Ford is putting them only on high performance vehicles.

Motorola's Van Tine sees a crucial test ahead for the growing market in accelerometers. "The basic make-or-break is whether you can incorporate self-test features so that the system can verify when the driver gets into the vehicle that the air bag is working," he says. He adds that Motorola is developing a silicon-based accelerometer and plans to sample it among test customers by midyear.

Hansen predicts that other applications—such as tire pressure, oil pressure, and air-conditioning sensors—will soon begin to pick up the slack for micromachined silicon pressure sensors. A specially designed EEPROM, for example, could measure not only oil level but could tell when engine oil had stopped working efficiently.


Worldwide market for automotive accelerometers

Source: The Hansen Report on Automotive Electronics

Although they can solve problems and add value, sensor failures have already caused costly headaches for car makers. In May 1989, Chrysler recalled 127,000 1984-model cars to repair an exhaust system sensor at no charge. If even half the car owners take Chrysler up on the offer, it could cost the company nearly $1 million.

Sensors are considered by some to be the weak link in automotive electronics, and many believe the weakness is in the packaging. Thermal stress can cause wire breakage and delamination of sensor materials. Hansen says improvements are needed in almost every aspect of the package, including better solders, increased use of surface-mount assembly, and rigid housings.

Environmental factors that drive the market can also have a limiting effect on technology. Heat is a growing problem in auto electronics, for example, since the growing number of components and the downsizing of engine compartments combine to reduce airflow. Hansen ascribes the reliance on the less-advanced variable-reluctance sensors in part because they can stand temperatures up to 200 degrees centigrade.

Meanwhile, U.S. auto makers' quality parameters for sensors are getting tougher; the acceptable defect level for a packaged sensor is well below 50 parts per million. That signals a change in the automotive electronics industry, where component tolerance levels traditionally have been fairly wide, says McGrath at PRTM. "But that's changing," he says. "Because of the environmental conditions in and around the car, these sensors have to be rugged."

Another breakthrough in reliability, he says, will come as manufacturers learn more about making the sensors and other information systems work together. The result, says McGrath, is a "vehicle area network" that works much like the local area computer networks used in corporate offices. Reliability, he said, will become a question of system failure, rather than component failure.

To simplify the network and streamline the tangle of wires linking controllers, sensors, actuators, and displays, manufacturers will have to rely heavily on multiplexing capability, requiring agreement on data-transmission standards—which is similar to the problem confronting computer-network market suppliers.

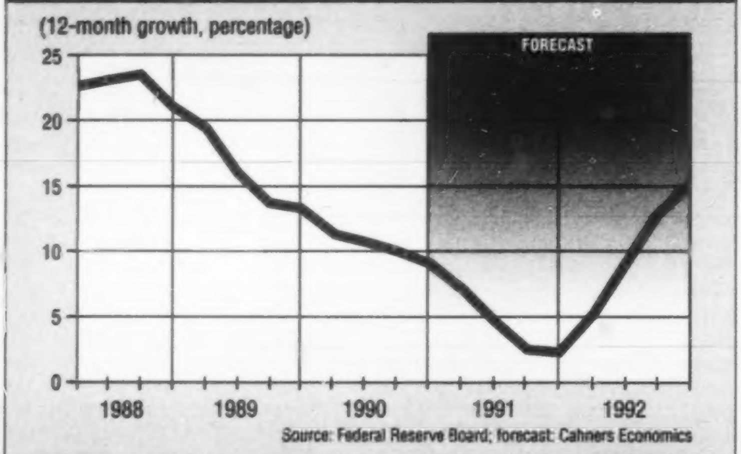
Concern about such issues is deep enough to prompt the Society of Automotive Engineers to form a special committee on multiplexing standards. Consultant Grace, who presented a paper on the subject to an SAE meeting last month, says the "one-wire" multiplexing issue will be a major one over the next five years.

Those issues even affect electronics companies that don't now make automotive sensors. In Chandler, Ariz., Fred Phail, strategic marketing manager for Intel Corp.'s automotive division, sees a growing role for the semiconductor industry as "smart" sensors become elements in a network, sharing data over a high-speed computer bus. But in another echo of the computer industry, Phail says auto makers and their suppliers will have to decide whether that bus will be 16- or 32-bit.

"The big question for the 1990s will be, 'How quickly does the electronic system become distributed rather than centralized?' " predicts Phail. "Software would have to make significant advances too, because of the need for redundancy in the system to keep the vehicle operating."

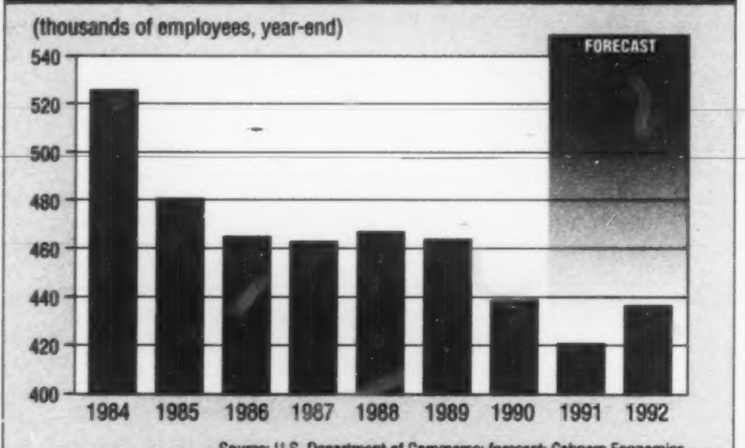
All in all, says McGrath with understatement, the evolution of electronic components into a control system "creates an interesting challenge for suppliers." ☐

Computer output growth dwindles...



Source: Federal Reserve Board; forecast: Cahners Economics

...so employment is cut back in 1991



Source: U.S. Department of Commerce; forecast: Cahners Economics

Computer payroll lowest since 1980

Government and company statistics have recently described a computer and peripheral equipment industry under extreme duress. Last winter, for example, U.S. factory production growth slowed to its lowest rate in 16 years; more recently, the Persian Gulf war sapped business confidence at a crucial juncture of the business cycle. But the truth remains that the industry has actually been slowing down and readjusting for some time in response to a weaker economy and a change in customer buying patterns.

A longer-term look at computer production growth shows that the rate of increase has been shrinking since August 1988. Even the last boom in 1988 was mild compared to the younger days of the industry. Consequently, the computer industry has been restructuring and purging its employment ranks. By the end of last year, U.S.-based computer and office equipment manufacturers employed only 439,300 workers—the smallest payroll since 1980.

Delivery times reflect the industry's weakness. According to *Purchasing* magazine, ELECTRONIC BUSINESS's sister publication, commercial buyers this past January waited an average of just 2.7 weeks for delivery of PCs. That's the shortest lead time since the survey began in 1985.

MADELINE FRANCHI

For more information on Cahners Economics' forecasting services, including seminars, newsletters, and database diskettes, contact Dan Buchan at (617) 630-2105, by fax at (617) 630-2100, or write Cahners Economics, 275 Washington St., Newton, MA 02158

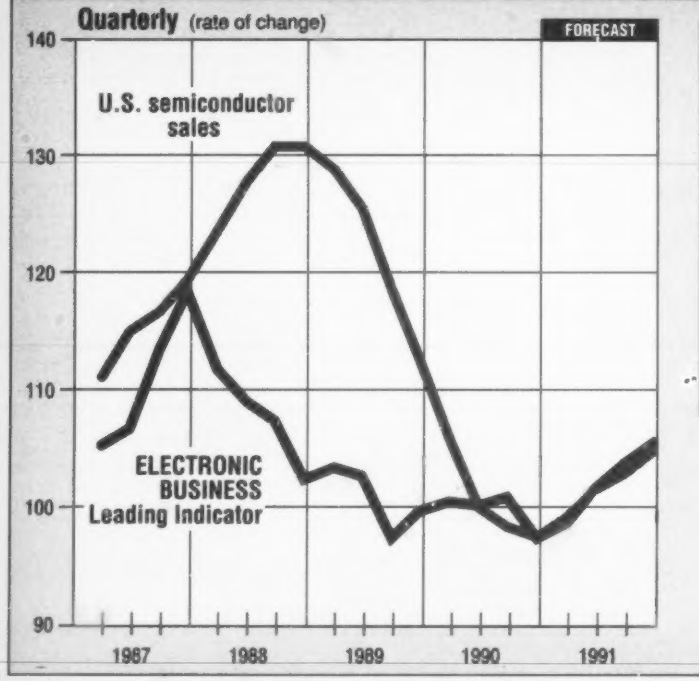
Computer market database

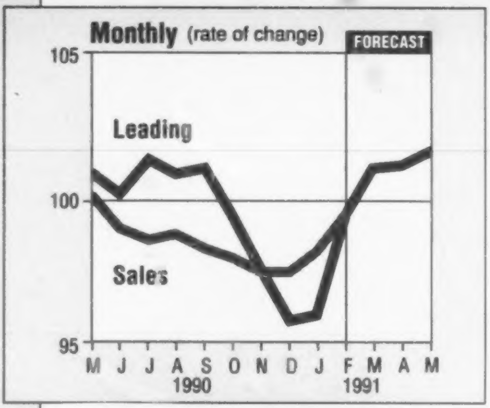
Latest quarter: 4th quarter 1989	Latest quarter	Previous quarter	Change	Year ago	Change	Next year	Change
Industrial production (SA,1987=100)	151.3	152.8	-1.0%	138.8	9.0%	159.9	5.7%
Shipments (SA, $ millions)	$18,233	$17,587	3.7%	$17,325	5.2%	$18,573	1.9%
New orders (SA, $ millions)	$16,967	$18,520	-8.4%	$17,506	-3.1%	$18,487	9.0%
Unfilled orders (SA, $ millions, end of qtr.)	$11,881	$13,147	-9.6%	$12,658	-6.1%	$12,130	2.1%
Inventory-to-shipment ratio (SA, end of qtr.)	1.91	2.04	—	2.11	—	1.97	—
All employees (thousands, end of qtr.)	439.3	441.0	-0.4%	464.6	-5.5%	421.3	-4.1%
Production workers (thousands, end of qtr.)	138.5	139.0	-0.4%	147.7	-6.2%	134.3	-3.0%
Business purchases (SAAR, $ billions)	$40.30	$39.73	1.4%	$40.76	-1.1%	$40.40	0.3%
Business purchases (SAAR, 1982 $ billions)	$128.54	$124.54	3.2%	$122.40	5.0%	$136.82	6.4%

SA = seasonally adjusted; SAAR = seasonally adjusted annualized rate; all other data is not seasonally adjusted
All data in current dollars, except where otherwise noted

Data sources: Federal Reserve Board, U.S. Bureau of the Census, and U.S. Bureau of Labor Statistics All data for SIC 357. Forecasts: Cahners Economics

ELECTRONIC BUSINESS Leading Indicator rebound begins this spring





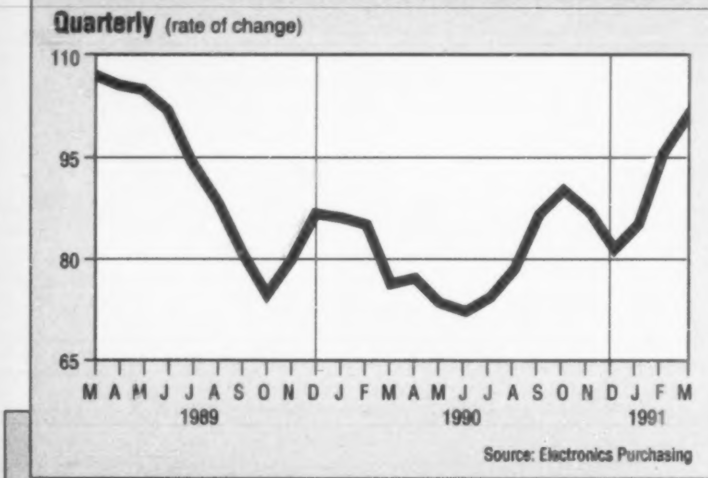
Spring marks rebound in Leading Indicator

The ELECTRONIC BUSINESS Leading Indicator (EBLI) took a positive step in February. Four of the six components of EBLI saw a healthy rise in early 1991, resulting in the long-awaited upturn.

Electronic components lead times offered the earliest signs of an imminent slowdown in the industry. From its last peak of 107.3 in March 1989, lead times growth slowed and then began to decline in July almost two years ago. Lead times sank to its lowest level of 72.3 in June 1990. Since then, lead times growth has been rising, with a slight break in the last two months of 1990, to a level of 101.8 in March. With the end of the war in the Persian Gulf, expect EBLI to continue to rise slowly to a forecasted peak of 106.6 in January 1992.

The ELECTRONIC BUSINESS Leading Indicator is a weighted composite of six statistics that tend to lead activity in the electronics industry. To obtain your complimentary background paper, contact Cahners Economics, 275 Washington St., Newton, MA 02158-1630, USA; telephone (617) 630-2119; fax (617) 630-2100.

Lead times for electronic components head up



Source: Electronics Purchasing

	Latest month	Previous month	Year ago	1990 average
ELECTRONIC BUSINESS Leading Indicator (rate of change, Feb.)	99.4	95.9	100.6	99.9
U.S. semiconductor bookings ($ millions, 3-month average, Feb.)	$1,272	$1,107	$1,218	$1,254
Weekly hours of semiconductor production workers (monthly average, Jan.)	39.7	40.9	40.2	40.4
Electronic components lead time index (1977 = 100, Mar.)	78.0	108.0	84.8	80.7
S&P's semiconductor stock price index (1970 =10, monthly average, Feb.)	70.3	59.6	61.9	64.6
Change in electronic components inventories ($ millions, SA, Jan.)	$33	-$15	-$4	$24
Contracts and orders for plant and equipment ($ billions, SA, Jan.)	$42.0	$44.9	$44.0	$42.1

SA = seasonally adjusted; all other data are not seasonally adjusted

Sources: Semiconductor Industry Association, U.S. Bureau of Labor Statistics, *Electronics Purchasing*, Standard & Poor's, U.S. Department of Commerce, U.S. Bureau of Economic Analysis

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FOR MANAGEMENT IN ELECTRONICS, COMPUTER, AND SYSTEMS COMPANIES — WORLDWIDE
MAY 20, 1991

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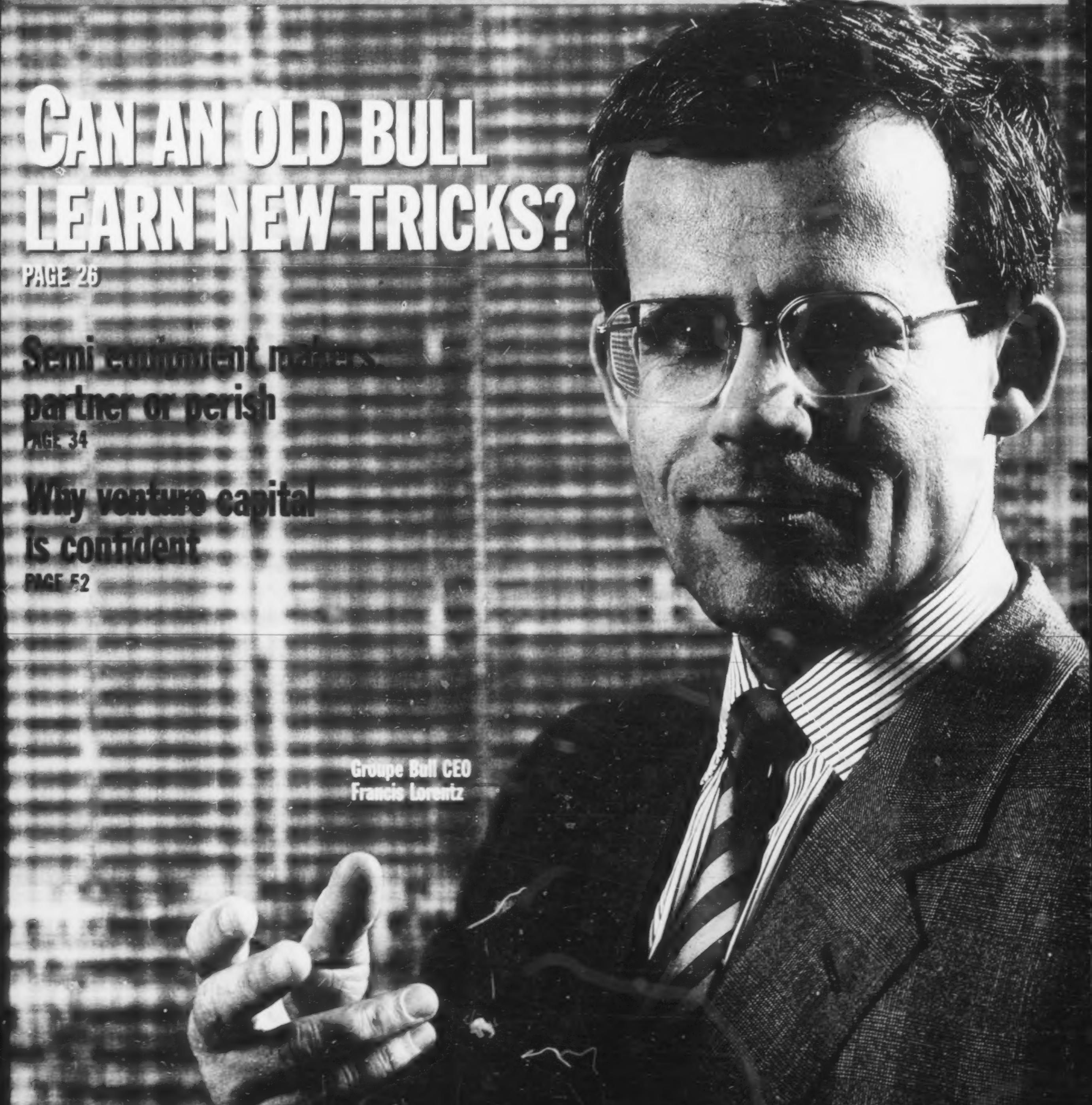

Groupe Bull CEO
Francis Lorentz

Electronic Business

FOR MANAGEMENT IN ELECTRONICS, COMPUTER, AND SYSTEMS COMPANIES—WORLDWIDE

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MAY 20, 1991

PAGE 26 Bull's Francis Lorentz: "We have no choice but to break even by 1992"

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26 Can you teach an old Bull to do new tricks?

France's Groupe Bull is struggling to change its culture. Burdened by years of financial instability and losses totaling $1.48 billion since 1989, CEO Francis Lorentz must now transform the bleeding company into a profitable one—or at least break even by 1992. Can Bull survive on its own, or will the French government finally abandon its political offspring?

Cover: Steve Murez

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COVER STORY/GROUPE BULL

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Despite fewer capital sources these days, venture capitalists are a happy lot. The reason: The venture business is shrinking, which should result in larger profits. More money in fewer hands, meanwhile, has turned the business into a matter of "survival of the fittest"

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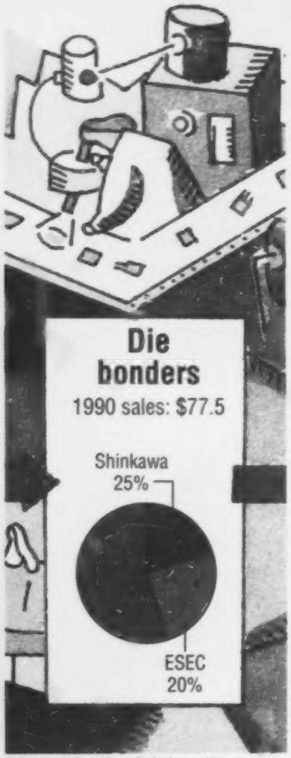

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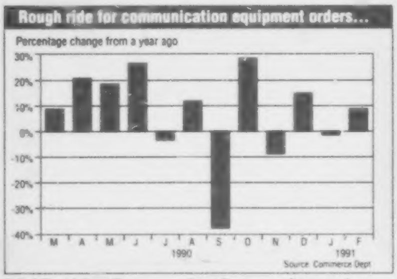

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Electronics evolution at work

Senior editor, Barbara Berkman

For a wounded corporation, there may be no upside to the principle of "survival of the fittest." In the marketplace, the process of natural selection can be brutal. The benefit falls to the industry that learns the lessons of survival.

This issue brings to light some of the evolutionary pressures that are putting the heat on electronics, computer, and systems companies. A case in point: Groupe Bull, the state-controlled dinosaur of France's computer industry, now a bleeding giant with losses totaling more than $1.2 billion.

As London bureau chief Barbara Berkman reports, Bull and its chief executive, Francis Lorentz, have one do-or-die route up the evolutionary ladder: Migrate to open standards based on Unix, and market itself as a global provider of computer services and of systems and applications expertise, rather than just hardware. That means joining Unisys, Digital Equipment Corp., and other competitors in an alien low-margin environment. Along the way, Lorentz must find a way to integrate the personal-computer product line that came with the 1989 acquisition of Zenith Data Systems.

Can Groupe Bull make the open-systems transition, change its image, and stem its losses? Lorentz himself draws the bottom line when he says: "We have no choice."

Further casualties of marketplace evolution aren't hard to find, especially if you look at the venture capital market. But here, at least, the positive results are becoming apparent, reports associate editor Dave Webb from our San Jose bureau.

For one thing, say his venture sources, the feast-then-famine experience of the 1980s has left venture partners wiser and more cautious, more likely to study new companies with an eye to good management as well as bright technical ideas.

For another, the scarcity of venture funding means less technological duplication among U.S. start-ups, easing the competition among fledgling companies and reducing the risk of failure and subsequent bargain-basement takeovers by foreign companies.

One U.S. industry abandoned by venture capitalists is the manufacture of semiconductor production equipment, once the preserve of U.S. companies but now a stronghold of Japanese domination. This issue looks at how U.S. manufacturers are banding together to withstand the pressure from abroad. As contributing editor Valerie Rice reports, the effort seems to be paying off.

JOHN PARKER, contributing editor

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other companies, and signed up resellers who use its extensive, precise digital road maps of the U.S. and Europe in applications far more diversified than the company's original concept. It was acquired by Rupert Murdoch's News Corporation, which sees moneymaking potential in using digital road maps as an advertising medium. The Etak executives envision a world where a family driving along the road could punch in a request on the on-board navigation system, and the next five restaurants would be listed. At home, a database offering access to a digitized, mapped version of the Yellow Pages could provide a financial gusher. The U.S. Yellow Pages generates about $8 billion in revenue annually, notes Honey.

TERI SPRACKLAND

COMMUNICATIONS

Shaky times for U.K.'s cellular phone market

IN THE AFTERMATH of deregulation, the British telecom market is Europe's most liberalized. But that hasn't made it easy for vendors that sell into that market, and this year has been marked by consolidation in Britain's mobile industry.

Telepoint services—operated on one-way, CT-2 digital cordless technology based on the U.K.'s common air interface standard (CAI)—are in a tizzy. With no sight of profits in the near future, Philips and Shell Oil backed out of the BYPS Communications consortium, leaving Barclays Bank with a 5% stake after members sold BYPS to Hong Kong paging and cellular phone giant Hutchison Telecom last February. Now, Hutchison has amassed wide interests in the U.K. market, including cellular service provision, mobile data, paging, and telepoint operations.

Remaining telepoint operators, Mercury Callpoint and Phonepoint, are carrying on. Mercury is staying quiet on the investment front until the rest of Europe joins Britain in approving the CAI standard. Phonepoint, however, plans a major advertising campaign this summer, "almost relaunching the service," says Gail Kirby, mobile communications consultant with BIS Strategic Decisions in Luton, England.

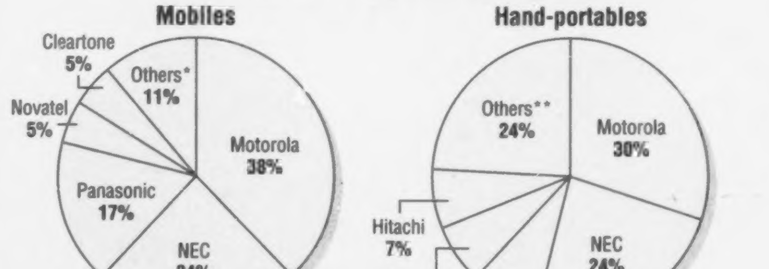
Meanwhile, mobile phone service providers fell from 50 to 35 after several acquisitions and bankruptcies. The problem: The rate of growth of cellular in the U.K. is falling fast because of the recession and the failure of many subscribers to pay their bills. What's more, Britain's chancellor, calling mobile phones a scourge of modern times that make motorways unsafe, slapped a £200 (about $360) income tax on each mobile phone used for business. The tax should affect telepoint and personal communication network phones, as well.

How will that tax affect equipment makers such as Motorola Inc. and Nokia? With business booming, not much. Nokia bought U.K. handset maker Technophone in February, boosting Nokia's share of the European hand-portable market to 14%. Sales of hand-portables in Europe grew 40% so far in 1990, compared with 30% a year earlier, says BIS.

BARBARA N. BERKMAN

Mobile and hand-portable equipment market

1990 U.K. market share by number of subscribers



Total number of subscibers: 1.2 million

*Includes Mobira and Philips

**Includes Panasonic, Technophone, and Kokusai

Source: BIS Strategic Decisions

FINANCING

Charge a new chip to your Visa card

GARY KENNEDY doesn't take American Express, but he will take Visa or MasterCard from people who just have to get prototype chips in a hurry. Twelve prototype chips will set you back a mere $1,500 and can be delivered to your door in about four weeks, claims Kennedy, the president of Orbit Semiconductor Inc., based in Sunnyvale, Calif.

That compares with typical prototyping costs of more than $65,000 and turnaround times of three months or longer, says Kennedy. What's the catch? Well, you will need a Sun workstation that will cost you around $13,000, plus a set of design tools either from the University of California at Berkeley (for full custom designs) or from the Microelectronics Center of North Carolina in Research Triangle Park, N.C. (for standard cell designs). The Berkeley tools are almost free, while the MCNC tools go for a paltry $5,000.

What does Orbit do in all this? Harried IC designers send Orbit a tape of a chip design and give a charge card number, and Orbit takes care of the rest. Orbit is a semiconductor company that has no products. The company provides only the service of making chips for other people, either in prototype form or in relatively low volumes. Last year Orbit did $25.5 million in making other people's chips.

The new prototyping service, called Foresight, is an attempt to bring cost-effective design tools and services to "the guy who's designing ICs in his basement," says Kennedy.

So far, some 45 customers have taken advantage of Orbit's Foresight service and a couple of them have actually charged the fee to plastic. Call (800) 331-4617 or, in California, (800) 647-0222.

JEFFREY BAIRSTOW

Semi equipment makers: partner or perish

U.S. semiconductor production equipment makers are being forced into partnering and other creative alternatives to financial failure

BY VALERIE RICE

"You need to be a masochist to stay in this industry."

Those chilling words from William Elder, CEO of Genus Inc. in Mountain View, Calif., could have been uttered by almost any executive in the embattled U.S. semiconductor equipment industry. As Elder points out, things are tough right now.

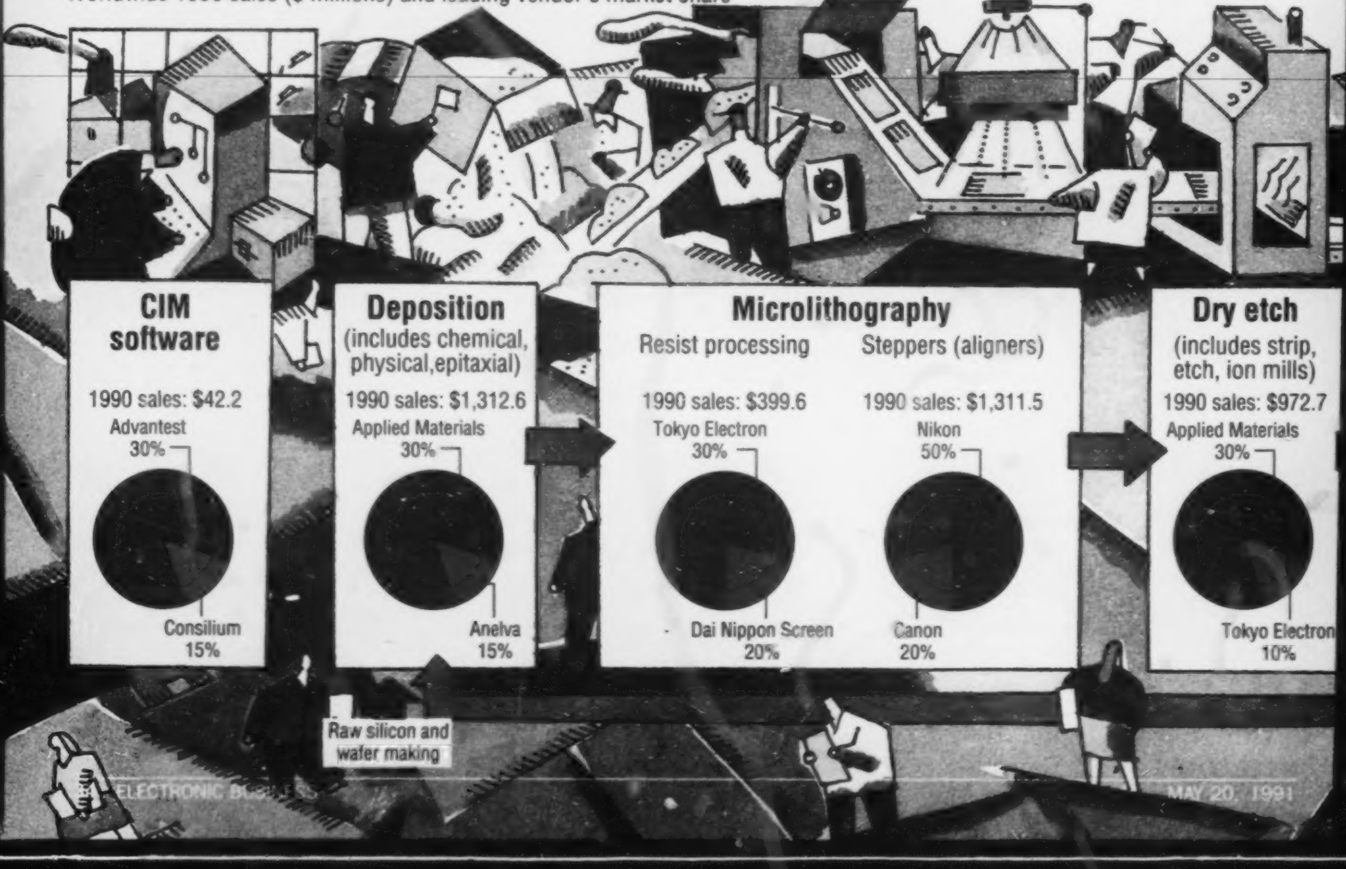
Plagued by insufficient capital, poor return on investment, and rapidly declining market share, the equipment industry in the United States has been overwhelmed by competition from better-funded Japanese companies. In less than 10 years, the U.S. industry has gone from owning the world market to lagging seriously behind Japan, which now is home to six of the ten largest equipment companies in the world. The equipment business has such a poor reputation for financial performance that venture capitalists have virtually abandoned it. Even the industry's bellwether, the mighty Santa Clara, Calif.-based Applied Materials Inc., was forced into layoffs earlier this year.

Unless changes are made, the outlook is not pleasant. Two recent studies on competitiveness singled out the U.S. equipment business as one of the weakest segments of the electronics food chain. One study, the second annual report from the National Advisory Committee on Semiconductors, said the U.S. industry will fall irretrievably behind Japan unless another $1.2 billion in capital is poured into it in the next 24 months.

The industry cannot afford to sit back and wait for government to

Semiconductor manufacturing and inspection equipment process

Worldwide 1990 sales ($ millions) and leading vendor's market share



help—counting on a remedy that is likely never to materialize, executives say. So instead, it has come up with some prescriptions for its own cure, a cure that companies can implement at little or no cost. And many believe that these home-grown solutions are beginning to work.

"Over the last 20 years we have let our industry as a whole slip away," states Papken Der Torossian, chairman of Silicon Valley Group Inc. in San Jose. "But now we are doing something. I feel very optimistic." From informal partnerships between competitors and closer ties with customers to equipment standards and mini-consortia, the industry hopes to regain lost ground. None of these are quick fixes, however, and many continue to believe only government-sponsored changes in areas like tax and depreciation laws will put them back on the road to competitiveness.

Strange bedfellows

Ask Roger Emerick, chairman of Fremont, Calif.-based Lam Research Corp., what brought the U.S. equipment industry to its knees and he'll answer, "The lack of partnerships." The Japanese, he says, are very good at working together; U.S. companies shy away from any kind of close cooperation.

But no more, Emerick says. Lam, Varian Associates Inc., Novellus Systems Inc., Genus, Silicon Valley Group, and others are slowly finding creative and mutually beneficial ways to team up with their competitors.

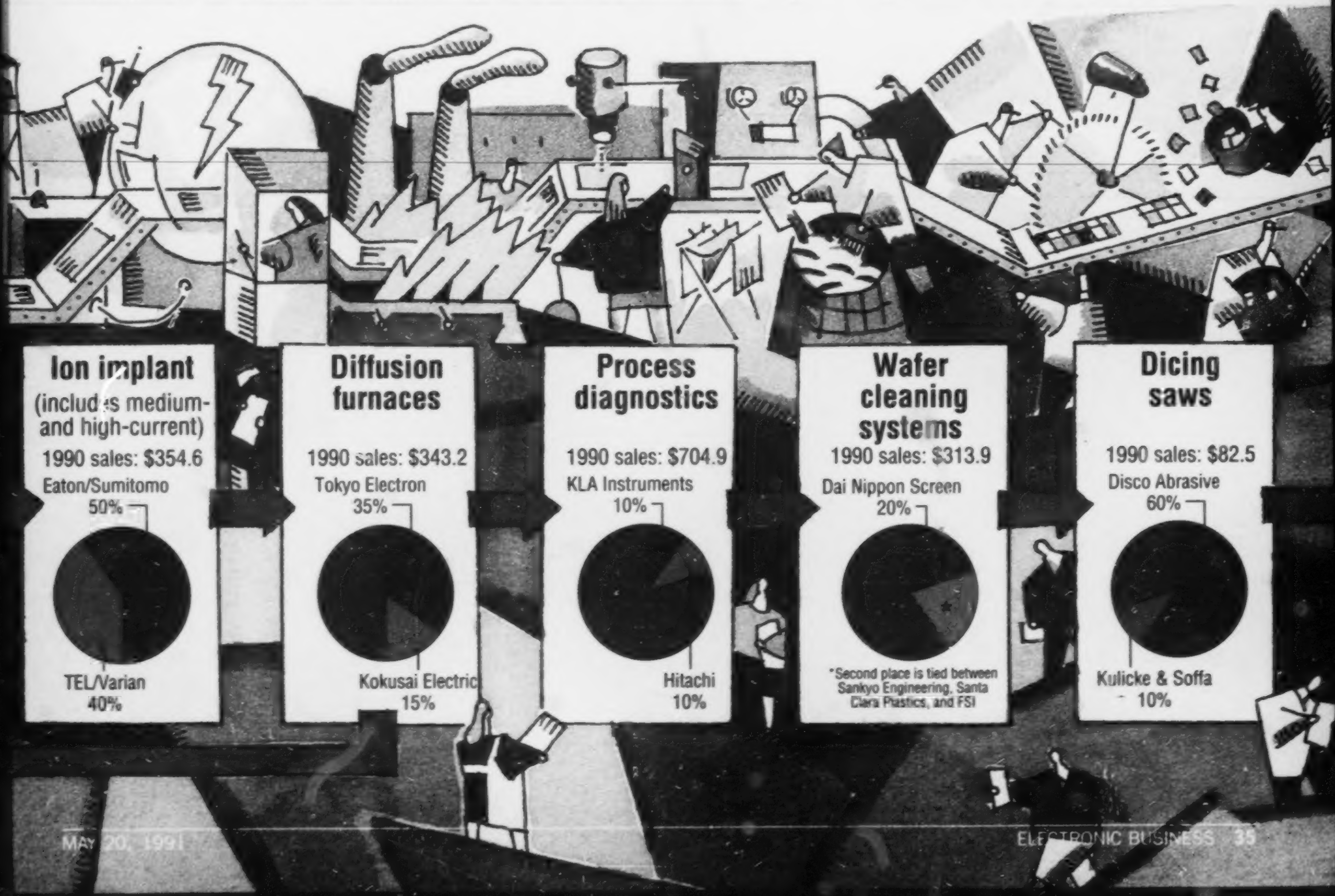
In Lam's case, Emerick was approached by Novellus chief executive Robert Graham, who needed an etch system to sell with his tungsten chemical vapor deposition machine. After making sure the machines worked well together, the two companies made a joint sales call to San Jose-based Cypress Semiconductor Corp. and got the sale.

And the partnering isn't stopping there. Novellus is also talking to Varian and Genus about similar deals, Graham says. "There's a lot of synergy here. And it absolutely does work. We showed [by teaming with Lam] that you can have a good system that works without being

Top 5 semi production equipment makers

1980	1990
Perkin-Elmer	● Tokyo Electron
GCA	● Nikon
Applied Materials	Applied Materials
Fairchild TSG	● Advantest
Varian	● Canon

Source: NCR Corp.



hooked together. It cost the customer more money by selling the systems separately, but he got a better wafer out of it. This way the market size is going to expand."

Emerick believes these deals will form a template for how the industry should do business. "This industry has changed a lot over the last few years," he says. "This is the right solution."

VLSI Research Inc.'s president, G. Dan Hutcheson, agrees, calling the deal between Novellus and Lam "astounding. That's something that, for years, people said would never happen. We didn't think it was possible for Bob and Roger to sit in the same room, let alone do a cooperative agreement."

But Graham says these loose relationships are a must if the industry is ever to address its single largest problem: trying to do too much. "We are all bent on saying we should be the best, but we should not try to do everything," he insists. "You have to leverage with other vendors."

Teaming up with competitors is not the only answer. Sematech, the semiconductor manufacturing con-

Where are the customers?

As if the U.S. semiconductor equipment industry doesn't have enough problems, now its customers are disappearing.

According to data from San Jose market research firm VLSI Research Inc., U.S. semiconductor companies just aren't buying that much equipment anymore. In fact, they don't manufacture that much anymore and most U.S. start-ups depend on offshore foundries to make their chips. Thus, the onetime primary market for U.S.-made equipment is dwindling.

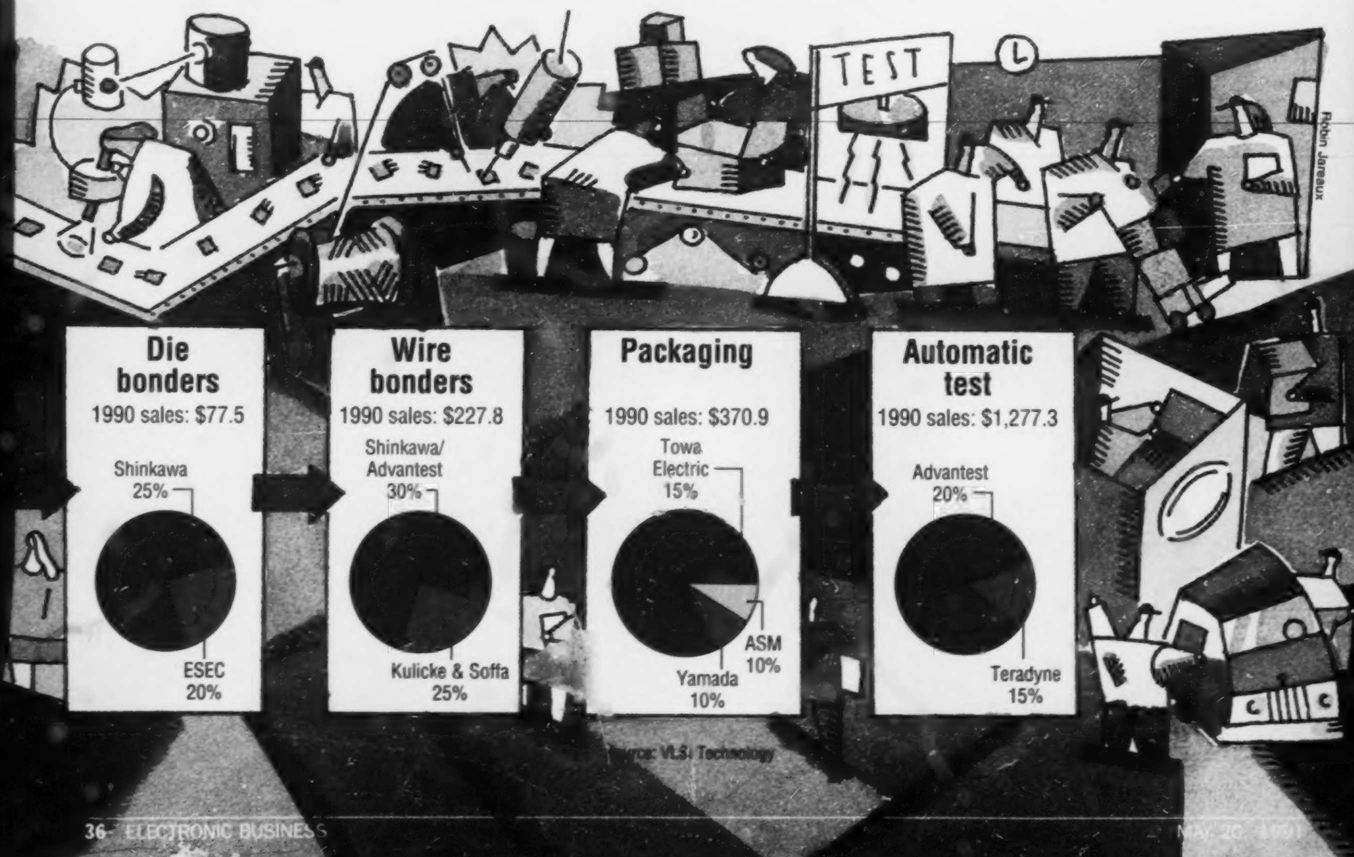
The market is, however, growing quickly in the Asia/Pacific region. But while Japan's semiconductor market is the world's largest, it is also one of the hardest to penetrate. For the nearly 800 equipment and materials companies that make up the U.S. industry—the vast majority of which are under $20 million a year in sales—that is bad news.

Large companies like Applied Materials Inc. in Santa Clara, Calif., sell about 60% of their equipment in Japan. But small companies lacking resources will have a difficult time following suit.

"The more sophisticated the technology gets, the more a big company is unwilling to take a risk on a company it doesn't know. A lot of small companies are going to be squeezed out of here," says William Elder, CEO of Mountain View, Calif.-based Genus Inc.

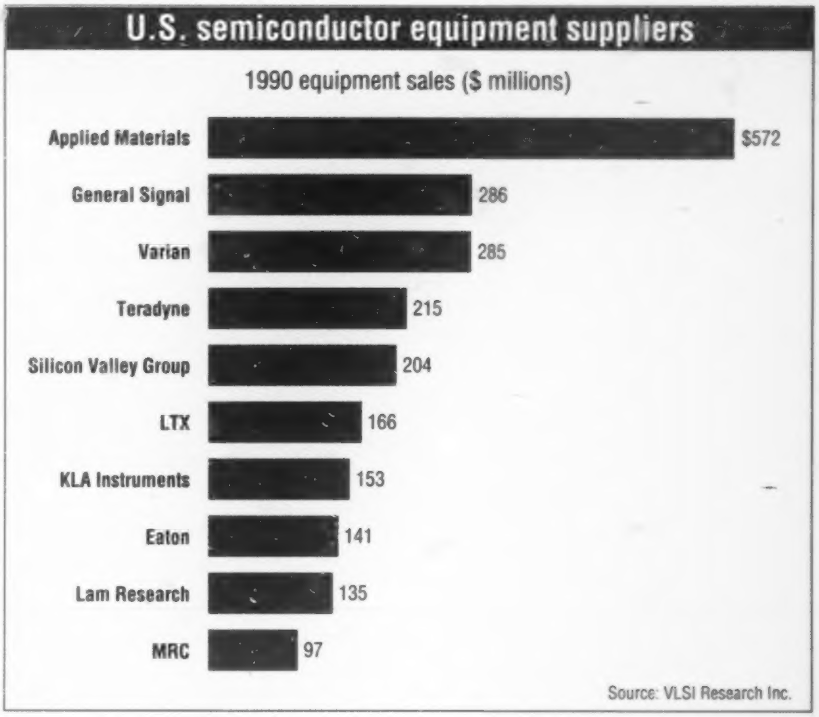
What this will mean is more consolidation in the industry, experts believe. "The guys operating out of their garages aren't going to be in business anymore," warns Silicon Valley Group's Papken Der Torossian.

On a positive note, the Semiconductor Equipment and Materials International trade association is trying to make it easier for small U.S. equipment companies to sell in Japan by setting up group trade tours designed just for them. ☐



Robin Jareaux

Source: VLSI Technology



Source: VLSI Research Inc.

sortium in Austin, has tried for four years to get its member chip companies to talk to their equipment suppliers—a novel idea in the United States, and something many believe the Japanese do very well.

"One initial goal of Sematech was to learn how to work together, and that's the most important trend right now in the semiconductor equipment industry," Hutcheson says. "It's difficult to change attitudes. It's been an adversarial business between chip and equipment companies for 20 to 30 years."

There are signs it is slowly changing, however. At Silicon Valley Group, a team of engineers from Motorola Inc. are working closely with one of the company's engineering teams to develop a new product, says Der Torossian. "Ultimately, everyone is going to benefit from that partnership," Der Torossian says, and he credits Sematech and its equipment arm, Semi-Sematech, with bringing the two sides together.

Genus's Elder agrees. "For the first time semiconductor companies are opening up and saying, 'Here are the specifications we want.' If you meet the specifications, you get the contract. There's none of this 'I'm not going to buy this unless you knock off 5%,' or anything like that."

The Sematech connection allows even small companies to get a foot in the door at large U.S. operations, Elder says. That's important at a time when fewer and fewer U.S. companies are buying equipment (see "Where are the customers?"). Along with its role as a communications facilitator, Sematech gives out awards to equipment companies that bid on research projects based on specifications supplied by Sematech member companies.

To date, Sematech has given out 59 grants for either equipment-improvement programs or joint-development programs, says Peggy Haggerty, Semi-Sematech vice president for public policy. A little over 40% of those awards have gone to companies with sales of under $10 million per year.

Some executives believe that this money, combined with R&D dollars from private companies, can help pull the industry out of its slump by boosting investment. Over the last 10 years, notes Der Torossian, the industry has spent an average of $200 million per year on R&D, or about 10% of sales. He adds that by the end of the decade, "we'll be spending $1.5 billion on R&D, or close to 16% of sales."

Setting higher standards

An international standards body doesn't seem an obvious place to look for help for the U.S. equipment industry, but the Modular Equipment Standards Architecture (MESA) movement may turn out to help the U.S. more than other countries, experts believe.

MESA, which recently became part of the Semiconductor Equipment and Materials International trade association, was started by industry leaders several years ago to find a way to take advantage of growing interest in modular equipment. For such equipment to function effectively, all pieces of the system must be standardized, analysts say. "MESA leverages the entire industry's efforts," says Hutcheson. "There is a significant value added for American companies."

U.S. equipment companies do a good job with process development, Hutcheson thinks, but they lack the economies of scale to fully de-bug them—U.S. equipment simply breaks down more often than Japanese equipment. With the MESA standards, U.S. companies will be able to focus on one part of the equation and build enough machines to ensure their reliability, he says. Hutcheson points to companies like Rapro Technology Inc. in Fremont, which is working on a MESA-standard wafer handler, as an example of a small company that is benefitting from working with the standards group.

In fact, MESA may be a boon to the hundreds of very small equipment companies in the United States, Lam's Emerick believes. "There is going to be much more investment in wafer handling and software, and a lot of little companies are going to be able to stay alive by teaming up to work in these areas," Emerick says.

The consortium cure

The most novel and, in many ways, the most promising solution to the industry's woes is a partnership between companies and their semiconductor customers—what some call a mini-consortium. But examples of this are tough to come by. One-year-old Etec Systems Inc., a Hayward, Calif.-based supplier of electron beam lithography equipment, is the

Why money won't help

Can money alone solve the U.S. semiconductor equipment industry's woes?

Maybe not. Many industry executives argue that money will neither get rid of the industry's structural problems nor force companies to change the behavior that got them into trouble.

There is no more eloquent advocate of this position than Robert Graham, CEO of Novellus Systems Inc. in San Jose. The well-known maverick firmly believes there is enough money in the industry. What it lacks, he thinks, is good management.

When capital is scarce, most equipment companies spend too much money on R&D, Graham says, partly because they have huge engineering staffs to keep busy. Novellus has a very small staff, which he augments occasionally with contract employees, keeping spending down to modest levels.

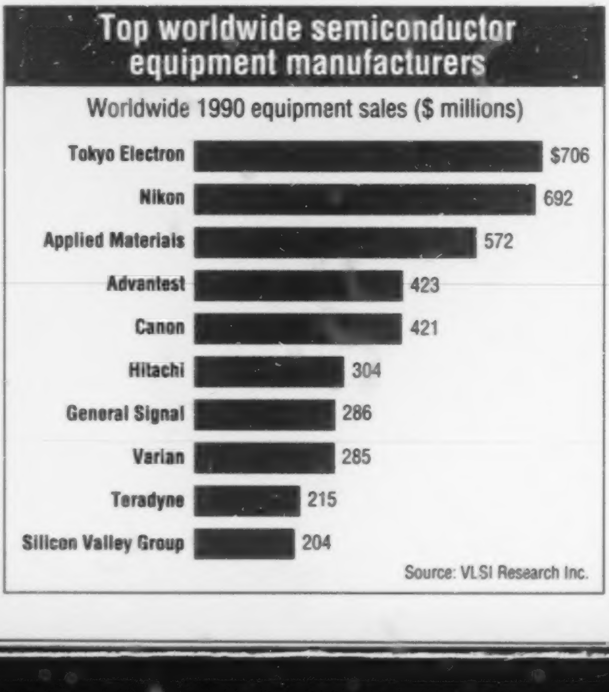
Novellus recently introduced a new machine that cost only $1.5 million to develop, a far cry from the $30 million or more some of his competitors spend to bring out new equipment. "We are doing R&D within our means," he says proudly. The company can accomplish this by following a business principle Graham calls "Little r, Big D." In the equipment business, one company usually controls basic research; Graham thinks companies should team up with the so-called research leader, use what's already been done, then focus their efforts on developing an improved system rather than starting from scratch. Strategic partnering allows a company to do that, Graham says, while saving huge amounts of time and money.

Novellus uses this strategy with its suppliers, customers, and competitors, giving the company the highest profit margins—60%—in the equipment industry.

It has also given Graham the flexbility to say no to a sale where he won't make his margins. But Mountain View, Calif.-based Genus Inc., which has struggled to stay in the black recently, can't afford *not* to discount sales, and company president William Elder disagrees with Graham's view of the world. "Pouring money in isn't the only solution, but it helps," he says. "In this business, where you have $1 million and $2 million pieces of equipment, one system is going to be the difference between being a hero or a bum [to stockholders]. If you have to cut $100,000 off the price to be a hero, you do it." ☐

only U.S. source for this type of machine. It may also be the first true consortium in the equipment industry. Etec was formed by IBM, DuPont, Micron Technology, Grumman, and Zitel, along with the management of Perkin-Elmer's former Electron Beam Technology Division.

Although company president Tom Halloran says it's a little early to predict whether Etec can serve as a model for the industry, things are "so far so good. We turned the company profitable, and in the first half of the year we are meeting or exceeding our plan."



Top worldwide semiconductor equipment manufacturers

Worldwide 1990 equipment sales ($ millions)

Source: VLSI Research Inc.

Etec is private and Halloran declines to disclose its earnings, but he claims that this year it is up 50% over last year and the backlog is more than double. In other words, "We're launched. Customers like us, and they're comfortable with the players."

But the trick to Etec's long-term success is its investors, he believes. "Our time horizons are not necessarily next month. Because of the nature of our investors, we are in it for the long term."

Halloran warns, however, that consortia are not easy to set up. In Etec's case, it was "all in what we were asking people to do. There were enough players investing small amounts of money so that the deal was structured as a win-win. Being able to identify a strategic advantage to an alliance partner is a critical factor. Without it you don't have a consortium."

Silicon Valley Group's Lithography systems operation is also a version of a mini-consortium. The company acquired the troubled operation from Perkin-Elmer with financial assistance from both IBM and Sematech. The arrangement allowed SVG to purchase the division, and kept the technology in U.S. hands.

Despite all the effort going into industry-driven solutions, executives still hope government will step in and help out. "We aren't looking for a handout," Der Torossian stresses, "but the government has a responsibility to help itself. The government is *us* too."

In particular, the industry hopes to see changes in equipment depreciation schedules, the capital gains tax, and R&D incentives that would make the business climate in the United States more hospitable. "There is a lot we can do ourselves," according to Semi-Sematech's Haggerty. "But there's a lot only the government can do." ☐

Why venture capitalists are quietly bullish

Despite less cash in the coffers, the venture capital community is optimistic about its future

BY DAVE WEBB

Donald Valentine ought to have been upset. At a recent electronics industry financial conference, not only were there fewer companies vying for venture capital than in the past, but there were also fewer venture capitalists with money to invest. Instead Valentine, a partner at Sequoia Capital in Menlo Park, Calif., was practically euphoric. "It was a field day," he recalls. "In the past that meeting has been attended by hundreds of companies [seeking financing]. This year there were just three dozen."

In a time when venture funds continue to be neglected by capital sources and returns on long-term investments are depressingly meager, Valentine and his peers might well view the implications of that meeting with grave alarm. But the venture capital field is changing, and it is doing so in ways that venture capitalists such as Valentine view as positive for the industry. This year and next should be profitable for venture capitalists, largely because the venture business—which needed to become smaller—has, in fact, done so.

Venture fund investors have been diverting the little money they made from short-term funds into other types of investments. Because less money is available, the number of funds being reinvested has decreased dramatically.

According to Venture Economics Publishing Co. in Needham, Mass., 57 funds worth $1.8 billion were either closed or partially closed (ready to be invested) in 1990. Of those funds, 41 were actually follow-on funds—in other words, "new" funds raised by previously established management teams. In total, $1.85 billion was available for investment at the end of 1990 compared with the $2.4 billion that was available in 1989.

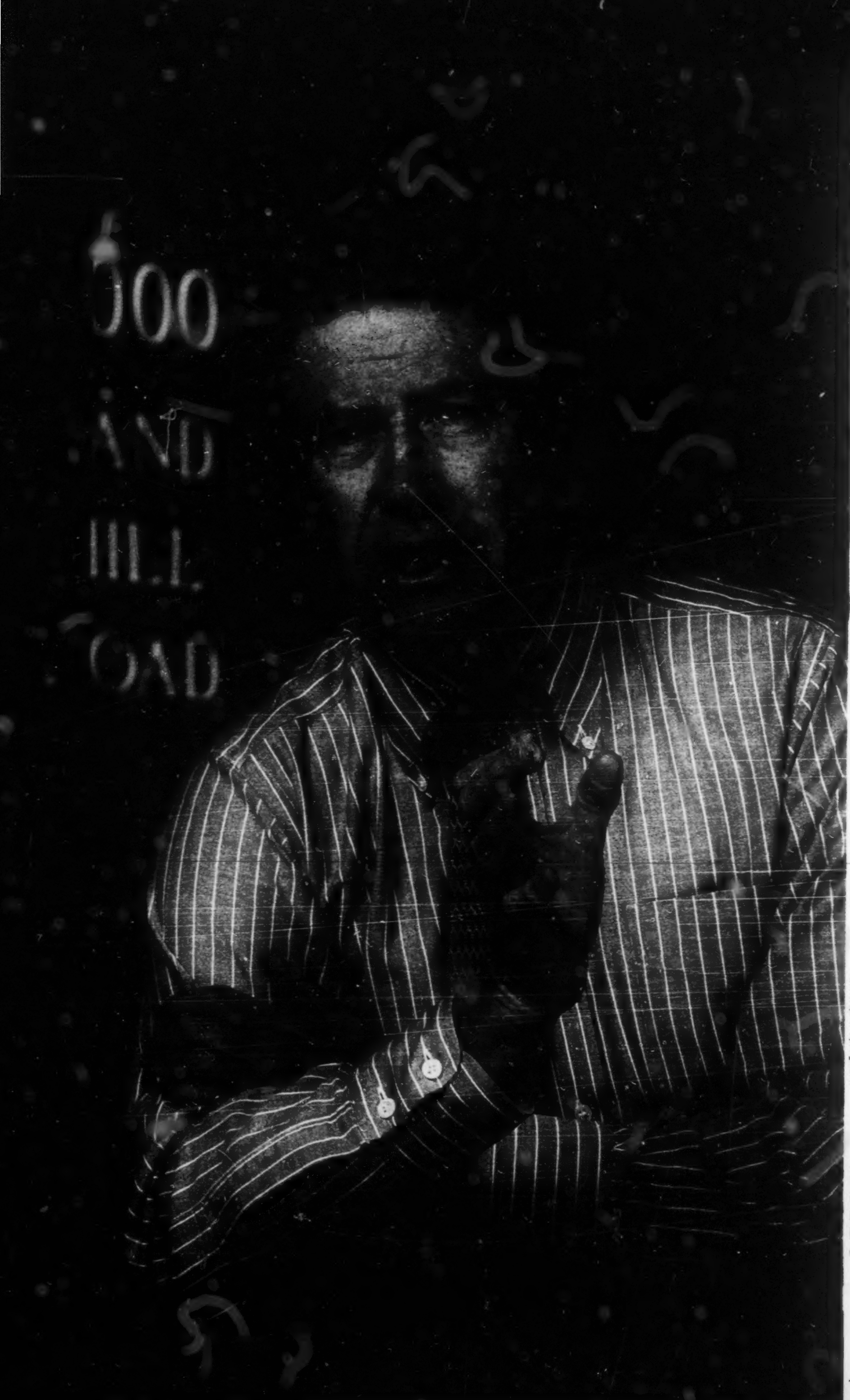
"Basically what's happening is that the funds aren't being re-funded," says Stephen Piper, a Venture Economics spokesperson. Out of the six major groups of fund contributors defined by Venture Economics, only two—pension funds and individual investments or trusts—increased their contributions to capital funds. The rest (see chart) sought greener pastures for higher returns. Real estate, stocks, and junk bonds were among those investments receiving contributions that might have otherwise gone into venture capital funds.

"Corporations, especially, are pulling out of venture capital," says Piper. "There's not only an uneasiness about venture capital in general, but corporations have gone through a learning curve. They got into the market in the early 1980s to see what it was like but have since pulled back to make later-stage funding rather than initial seed investments. They'd rather pay a premium now and know what they're getting."

More money is now in the hands of fewer venture partnerships. "It's survival of the fittest," says Sequoia's Valentine. "The strong will survive, and the weak will fall by the wayside. The number of venture firms that won't survive will far outnumber those that will start up."

This retrenchment is one of the consequences of a hell-for-leather investment orgy of the 1980s. That's as much the fault of the investors as of the partnerships that gathered the funds. "What investors did was put too much money into the hands of venture capitalists," says William Davidow, a partner of Mohr, Davidow Ventures in Menlo Park, Calif. "Less of that money should have gone into venture capital, and more should have gone into conventional investments."

In the 1980s the glut of venture capital financed start-ups across a broad swath of high technology industries. Often this resulted in the formation of look-alike companies with similar products or market focuses, which created competition that was too intense for such young, immature rivals. The companies frequently failed or were acquired at fire-sale prices that left investors empty-handed. Worse, in Valentine's view, the same struggling companies were picked up by foreign companies, often Japanese, which had the resources to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Christopher Springmann

Sequoia's Donald Valentine: The venture capital business is becoming "survival of the fittest"

capitalize on American innovation.

"The 1985 to 1990 timeframe was a period of enormous excess. The venture partnership community had 10 times too much money. We tended to overfinance technology only to let international interests pick it up for a song. That's the insidious part," says Valentine. "The number of computer-related companies being financed has dropped dramatically. I think that's great."

William Davidow: Investors should have put more money into conventional investments and less into venture capital

Valentine believes there aren't as many bright stars in management as one would think by the number of companies started a few years ago, and he adds that the venture community doesn't have the capability to manage that many companies.

Fewer companies with venture capital funding means venture fund partners will be selecting start-ups more carefully for investments. One of the lessons learned from the past is the need to scrutinize the management of new companies. If a company has great technology but doesn't have a solid kernel of management expertise with a tight business plan, it won't get funded.

"The biggest single change in the industry is that a clever group of people are more likely to get funded than a clever technology," says 3i Corp.'s Jim Bass. "They are looking for management that understands a market and, most important of all, how to reach it."

A good time to start a company?

Despite a lingering recession with less venture money and fewer start-ups being funded, venture capitalists are encouraging entrepreneurs to take steps to get started now. "The timing is good because everything is slowed down. You catch the wave. When the economy turns around, you're ready. It's an ideal time to start a company," says Paul Wythes, a partner at Sutter Hill Ventures in Palo Alto. The recession may discourage potential entrepreneurs from leaving a current employer to develop a new product. On the other hand, there may not be much competitive development, so an entrepreneur can be well ahead on the technology curve when the economy rebounds.

The end of the recession is expected to spark a significant round of public offerings, some of which have already taken place in the wake of a dry period in 1990. Registered IPOs, as of the first of March, included Zilog, Picturetel, Symix Systems, and Simtek. Others offering second rounds include Dell Computer and AST Research. Sybase, Wellfleet Communications, and Network Computing Devices are all candidates for IPOs this year.

Mayfield Fund's F. Gibson Myers: By investing funds conventionally, IPOs are making everyone feel a lot better

But while money is liquidated by the offerings, much of it will go into the hands of institutions that are likely to invest conventionally instead of in new venture funds. Nevertheless, "IPOs are making everyone feel a lot better," says Mayfield Fund partner F. Gibson Myers.

Likely investments in 1991

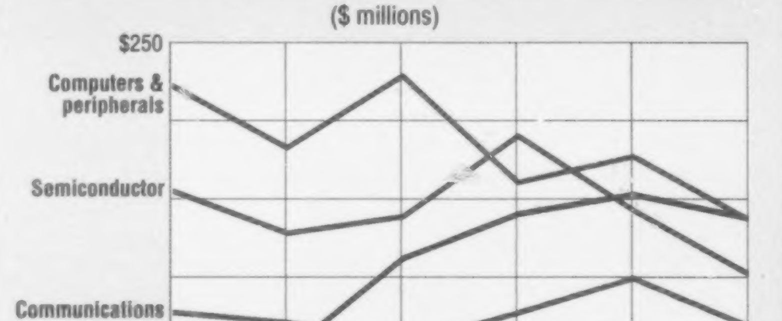
According to an Ernst & Young survey, $729.6 million was invested by venture firms in 1990. Out of the industries outlined in the survey, only the biotechnology/medical industry saw an increase in investment activity over the previous year. Communications, computers, semiconductors, computer peripherals, and software investments were down.

But the numbers can be misleading. Less venture money is available, but venture firms are eyeing software and communications (both computer network and telecommunications technologies) as two of the hot areas of investment opportunity. In software, pen-based computer and consumer game program innovators are attracting attention, as well as database and image system operating systems. Design automation is another fast-moving target of interest.

One of the few venture capital firm start-ups last year—Hummer, Winblad Venture Partners of Emeryville, Calif.—is "specializing" in software and received $35 million in institutional funding for start-up investments across the broad range of software market segments. "We still have to prove we can make money for investors," says partner John Hummer, "but we're bullish on innovation in software start-ups."

Telecommunications and computer network-related hardware and software are also promising areas of

Funds to computers fall while software rises



Source: Ernst & Young

Putting together the best package

Even during a recession, few venture capitalists will discourage a would-be entrepreneur from starting a company. But only about 1% of the proposals coming across most venture partners' desks get their serious attention. Fewer still get their money.

Given the current environment of tougher investment standards, how can you package your idea to maximize your chances of making the final cut?

First of all, be sure your CEO is experienced in the specific market in which you'll compete. "Build your company around the CEO," advises Stephen Coit, a general partner at Merrill, Pickard, Anderson & Eyre in Waltham, Mass. "Markets today are much more defined and complicated. It's critical that a CEO has a working knowledge of distribution in the start-up's market and of its targeted customers."

Second, determine if your marketing staff understands where and how your product will fit into the marketplace. Whiz-bang technology alone isn't enough. "A good [start-up] must be upfront with market research," Coit says. "Do your competitive assessment of the market before you write the first word of software code."

Third, you should consider how capital-intensive your technology or product is. Hardware is naturally capital-intensive, so new software products seem to have an immediate advantage. Still, says Coit, "there are terrific opportunities for superlative hardware designs." The trick is to develop a low-cost strategy and to forego the high margins typical of earlier successful start-ups such as Apple Computer Inc. and Compaq Computer Corp. "Start-ups that can demonstrate a practical low-cost approach," says Coit, "are more likely to catch our eye."

A fourth criterion your ability to leverage the entrenched distribution-channel infrastructure that will help you to reach your customers. The more a company grasps the differences between a "channel-driven" philosophy and a "market-driven" philosophy, the more attractive it becomes to the venture industry.

Fifth, you must prove you can get a product through development and into production without having to raise second-round financing. Tackling a project with insufficient capital will only leave you twisting in the wind.

Sixth, coolly assess the soundness of your technology. For the venture capitalist, says Coit, the technology or the product must be both "compellingly deep" and clearly better, in terms of both user benefits and cost efficiency, than existing products or services. "Good designs are efficient, and it's efficiency that keeps costs down and makes an attractive product," he advises.

Finally, venture partners are on the lookout for start-ups that have the financial confidence of other sources. Institutions, banks, and other corporations often provide investment or financing alongside venture funds. Joint development and marketing agreements with well-established companies also generate support. "You have to prove you are adept at using capital," warns Coit. "We shy away from those projects that appear as if the capital intensity will be too great." □

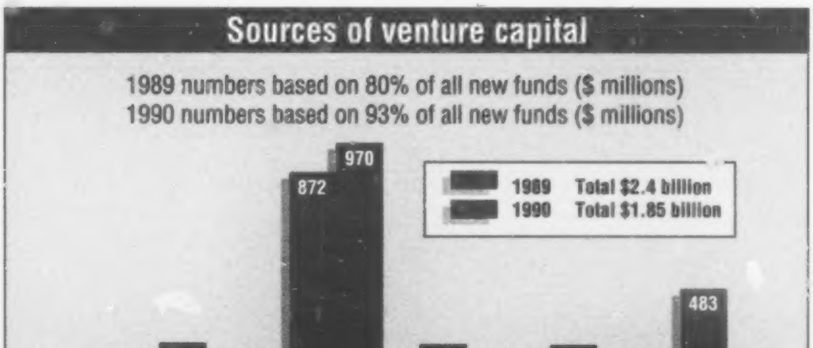
investment. Venture partnerships expect niche markets with such products as wireless telephones, wireless computer networks, and network management software to provide opportunities to grow several $50 million to $70 million companies.

Computer hardware gets mixed reviews. "The general feeling among venture partners is that it is getting hard to find something unique on the hardware side of the computer industry, while there is a lot of innovation taking place in software," says Sutter Hill's Wythes.

But partner Stephen Coit of Waltham, Mass.-based Merrill, Pickard, Anderson & Eyre says, "I think there are terrific opportunities for companies that can produce superlative hardware designs [because of enabling software innovation]." He is quick to warn, however: "The market is much less forgiving of 'me-too' products."

The right products with the right management can spark venture partners' interest. As New York-based Technologic Partners' Richard Shaffer says, "I don't know of any exciting companies that can't get all the money they want right now."

"But don't forget," adds Hummer, "there is a large amount of luck in our business. It's one thing to get elected, but it's another to know how to govern and do it successfully." □



Source: Venture Economics

VENTURE CAPITAL DIRECTORY

Who's who in venture capital

A directory of venture capital contacts

Company/Address								
3i Ventures 99 High St., #1530 Boston, MA 02116	Allan R. Ferguson 617-542-8560	=	169	19	125	16	NA	Transwitch, Unifi Communications, Simtelligence
Accel Partners One Palmer Square Princeton, NJ 08542	Don H. Gooding 609-683-4500	=	95	80	[illegible]	41	200	The Santa Cruz Operation, Picturetel, Synopsys
Advanced Technology 10 Post Office Square, #970 Boston, MA 02109	Albert E. Paladino 617-423-4050	◆	26	17	16	8	60	Actel, Microwave Networks, Performance Semiconductor
Alpha Partners 2200 Sand Hill Rd. #250 Menlo Park, CA 94025	Brian J. Grossi 415-854-7024	◆	NA	NA	26	21	NA	Bell Microproducts, Pinnacle Systems, Viewpoint Systems
AVI Management Partners 3000 Sand Hill Rd., Bldg. 3-280 Menlo Park, CA 94025	Peter L. Wolken 415-854-4470	◆	36	35	32	31	65	Power Up Software, Micronics Computers, Sierra
BancBoston Ventures 100 Federal St. Boston, MA 02110	Henry W. Newman 617-434-2442	=	30	9	40	17	NA	InFocus, Xyplex, Mattson
Battery Ventures 200 Portland St. Boston, MA 02114	Richard D. Frisbie 617-367-1011	◆	50	50	30	30	75	Marcam, In Focus Systems, Banyan
Bessemer Venture Partners 3000 Sand Hill Rd., Bldg. 3-225 Menlo Park, CA 94025	Neill Brownstein 415-854-2200	◆	100	50	50	22	NA	Parametric Technology, Versant Object Technologies, Vitelic
Brantley Venture Partners 20600 Chagrin Blvd. Shaker Heights, OH 44122	Robert P. Pinkas 216-283-4800	◆	9	1.5	11	2	45	Implex, Ohmicron
Brentwood Associates 11150 Santa Monica Blvd., #1200 Los Angeles, CA 90025	G. Bradford Jones 213-477-6811	=	150	100	60	40	400	[illegible] Communications, Cirrus Logic, SynOptics
Burr, Egan, Deleage & Co. One Post Office Square, #3800 Boston, MA 02109	Jonathan Flint 617-482-8020	◆	215	75	115	47	318	SyQuest Technology, Broderbund Software, Cadre Technologies
Charles River Ventures 67 Batterymarch St. Boston, MA 02110	Barbara A. [illegible] 617-439-0477	◆	192	101	49	NA	NA	Parametric Technology, Chipcom, Xyplex
Charter Venture Capital 525 University Ave., #1500 Palo Alto, CA 95301	A. Barr Dolan 415-325-6953	◆	NA	NA	30	15	NA	Metricom, InterFax, ELF Technologies
Chatham Venture 120 Bedford St. Lexington, MA 02173	Euan [illegible] 617-863-0970	◆	2	2	11	10	[illegible]	[illegible] Systems, [illegible], Applix
Concord Partners 535 Madison Ave. New York, NY 10022	John Foster 212-906-7100	=	125	54	46	20	175	Sundisk, Cayman Systems, Metaphor Computer Systems
[illegible] Management 260 Franklin St., #530 Boston, MA 02110	Michael H. Shanahan 617-439-6130	=	30	25	NA	NA	34	Vicor, Banyan Systems, [illegible] Technology

VENTURE CAPITAL DIRECTORY

Company/Address	Contact/Phone	Investment plans over the next year	Dollar investment ($ millions) Total	Electronics	Number of companies invested in Total	Electronics	Total portfolio size	Some companies currently funding
El Dorado Ventures Two North Lake Ave., #480 Pasadena, CA 91101	Brent Rider 818-793-1936	▲	37	34	14	12	53	Novellus Systems, Cellular Data, Paradigm Technology
Euclid Partners 50 Rockefeller Plaza New York, NY 10020	Milton J. Pappas 212-489-1770	▲	13	8	12	7	50	Software Developers, Itron, Ascor
Fostin Capital P.O Box 67 Pittsburgh, PA 15230	William F. Woods 412-928-1400	=	36	16	44	20	75	Minc, Sherpa, Metallized Paper Corp. of America
Glenwood Management 3000 Sand Hill Rd., Bldg. 4-230 Menlo Park, CA 94025	Dag Tellefsen 415-854-8070	▲	35	30	26	23	75	Opus Systems, Array Technology, Paradigm Technology
Glynn Capital Management 3000 Sand Hill Rd., Bldg. 4-235 Menlo Park, CA 94025	John W. Glynn 415-854-2215	▲	17	15	24	21	25	Celeritek, Banyan Systems, Ultra Network Systems
Grace Horn Ventures 20300 Stevens Creek Blvd., #330 Cupertino, CA 95014	Dr. Mark Dubovoy 409-725-0774	▲	41	26	48	21	92	Interlink Electronics, IXYS, Micro Linear
Greylock Management One Federal St. Boston, MA 02110	William H. Helman 617-423-5525	▲	131	68	70	37	275	Banyan Systems, Ascend Communications, CATS Software
Hambro International 650 Madison Ave. New York, NY 10022	Julie Lane 212-288-7778	=	121	51	52	24	150	Rasna, Solectron, Edsun
Hancock Venture Capital One Financial Center Boston, MA 02111	Robert Wadsworth 617-350-4002	=	550	180	100	30	800	None supplied
Highland Capital Partners One International Place Boston, MA 02110	Paul A. Maeder 617-330-8765	▲	30	15	14	10	75	Sybase, SCH Inc., Avid Technology
HMS Capital Partners [illegible]0 Middlefiled Rd., #150 Menlo Park, CA 94025	R. G. Grey 415-324-4672	▼	12	12	11	11	17	Meridian Data Systems, Multipoint Networks
Hook Partners 3102 Oak Lawn Ave., #545 Dallas, TX 75219	David J. Hook 214-528-5451	▲	20	19	22	19	25	Vitesse Semiconductor, Pico Logic, Insite Peripherals
Idanta Partners 10975 Torreyana Rd., #304 San Diego, CA 92122	Dev Purkayastha 619-452-9690	▲	88	72	13	9	100	Iomega, Elite Microelectronics, Pacific Communication Sciences
Indosuez Ventures 3000 Sand Hill Rd. Bldg. 2-160 Menlo Park, CA 94025	David E. Gold 415-854-0587	=	25	20	25	20	34	Cisco Systems, Sierra, Vitesse
InterWest Partners 3000 Sand Hill Rd., Bldg. 3-255 Menlo Park, CA 94025	Therese J. Kollerer 415-854-8585	▲	NA	NA	NA	NA	250	Xilinx, Radius, Network Computing Devices
JAFCO America Ventures 180 Maiden Lane, 21st floor New York, NY 10038	Shoichi Fujikawa 212-269-8900	=	15	12	22	12	300	Micronix, Epoch Systems, Aehr Test
Kleiner Perkins Caufield & Byers 2200 Geng Rd., #205 Palo Alto, CA 94303	Floyd Kvamme 415-424-1660	=	400	300	100	70	545	GO, Radius, Proteon, Gazelle Microcircuits
Lawrence, Tyrrell, Ortale & Smith 515 Madison Ave., 29th floor New York, NY 10022	Brian Horey 212-826-9080	▲	61	17	35	11	115	Saber Software, Marcam, Viasoft

VENTURE CAPITAL DIRECTORY

Company/Address	Contact/Phone	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Massachusetts Technology 131 State St., #215 Boston, MA 02109	John F. Hodgman 617-723-4920	=	17	11	31	22	12	None supplied
Mayfield Fund 2200 Sand Hill Rd. Menlo Park, CA 94025	Glenn M. Mueller 415-854-5560	=	370	NA	67	47	276	Silicon Graphics, Mips, Aspect Telecommunications
[illegible] 3000 Sand Hill Rd., Bldg. 1-240 Menlo Park, CA 94025	Michael E. [illegible] 415-854-7236	NA	NA	NA	NA	NA	NA	None supplied
Montgomery Bridge/Pathfinder 600 Montgomery St., #2100 San Francisco, CA 94111	John C. Siegler 415-627-2039	=	100	75	46	34	60	Proteon, Retix, MicroLinear
Morgan, Holland Ventures One Liberty Square Boston, MA 02109	Jay Delahanty 617-423-1765	●	50	40	25	20	100	Star Semiconductor, Microwave Logic, Dataware Technologies
Morgenthaler Ventures 629 Euclid Ave. Cleveland, OH 44114	Theodore A. Laufik 216-621-3070	●	72	33	44	17	160	Hypres, Intelledex, Censtor
New England Capital One Washington Mall Boston, MA 02108	Tom Tremblay 617-573-6400	=	10	3	50	25	20	Credence Systems, MRS Technology, Banyan Systems
Newtek Ventures 500 Washington St., #720 San Francisco, CA 94111	John E. Hall 415-986-5711	●	20	15	23	16	50	Caere, Logic Modeling, Prometrix
Olympic Venture Partners 2420 Carillon Point Kirkland, WA 98033	George R. Clute 206-889-9192	●	NA	NA	27	20	55	[illegible], Syntellect, Lam Research
Paragon Venture Partners 3000 Sand Hill Rd., Bldg. 2-190 Menlo Park, CA 94025	Robert F. Kibble 415-854-8000	●	33	24	23	17	70	SynOptics, Four Pi Systems, Credence Systems
Partech International 101 California St., #3150 San Francisco, CA 94111	Vincent Worms 415-788-2929	●	100	50	20	8	200	Cadence, Verifone, Biosym
Pathfinder Venture Capital 7300 Metro Blvd., #585 Minneapolis, MN 55435	Brian P. Johnson 612-835-1121	●	60	25	53	22	100	Digital Systems Intl., Confertech Intl., Aetrium
Peregrine Ventures 1299 Ocean Ave., #300 Santa Monica, CA 90401	Gene Miller 213-458-1441	●	32	29	26	23	44	None supplied
Poly Ventures Polytechnic University, Rt. 110 Farmingdale, NY 11735	Shelley A. Harrison 516-249-4710	=	NA	NA	15	5	30	None supplied
[illegible] & Co. 233 N. Michigan Ave., #1812 Chicago, IL 60601	David C. Seidman 312-853-1812	NA	NA	NA	NA	NA	NA	None supplied
Sequoia Capital 300 Sand Hill Rd., Bldg. 4-280 Menlo Park, CA 94025	Donald T. Valentine 415-854-3927	NA	NA	NA	NA	NA	NA	None supplied
Shaw Venture Partners 111 Southwest Fifth Ave., #2200 Portland, OR 97204	Allan R. Shaw 503-228-4884	●	35	27	26	20	30	Actel, Protocol Systems, Sequent Computer Systems

Electronic Business

VENTURE CAPITAL DIRECTORY

Company/Address	Contact/Phone	Investment plans* over the next year	Dollar investment ($ millions) Total	Dollar investment ($ millions) Electronics	Number of companies invested in Total	Number of companies invested in Electronics	Total paid-in capital	Some companies currently funding
Sierra Ventures 3000 Sand Hill Rd., Bldg. 1-280 Menlo Park, CA 94025	Vincent H. Tobkin 415-854-1000	▲	82	71	28	21	100	Stratacom, Advantage Product Technology, Intuit
Sigma Partners 2884 Sand Hill Rd. Menlo Park, CA 94025	Lawrence G. Finch 415-854-1300	▲	50	45	40	37	120	None supplied
Spectra Enterprises 200 N. Westlake Blvd., #215 Westlake Village, CA 91362	James A. Cole 805-373-8537	=	13	12	18	16	23	Vitesse Semiconductor, Microwave Modules & Devices, EESOF
Sprout Group 140 Broadway New York, NY 10005	Richard E. Kroon 212-504-3600	▲	126	42	52	19	333	Ventone, Norand, Viewlogic Systems
SRB Management 13455 Noel Rd. Dallas, TX 75240	Sandy Fuehr 214-702-1100	▲	130	120	35	33	150	Proteon, Cyrix Semiconductor, Shared Resource Exchange
St. Paul Venture Capital 385 Washington St. St. Paul, MN 55102	Fredric R. Boswell 612-223-2135	▲	250	100	50	20	NA	Tricord Systems, BroadBand Technologies, Cayman Systems
TA Associates 45 Milk St. Boston, MA 02109	Stephen J. Gaal 617-574-6700	=	300	235	76	66	500	PrairieTek, Epoch Systems, BroadBand Technologies
Technology Venture Investors 3000 Sand Hill Rd., Bldg. 4-210 Menlo Park, CA 94025	Mark G. Wilson 415-854-7472	=	150	130	40	35	270	Farallon Computing, Intuit, Synopsis
Trinity Ventures 155 Bovet Rd., #700 San Mateo, CA 94402	Noel J. Fenton 415-358-9700	▲	37	21	26	15	53	Ikos, Alldata, Resonex
TVM Techno Venture 45 Milk St. Boston, MA 02109	Waldemar Jantz 617-457-5251	=	30	20	45	25	60	Inkleaf, Digital Radio Laboratories, Keyfile
Venrock Associates 30 Rockefeller Plaza #5508 New York, NY 10112	Peter O. Crisp 212-649-5657	▲	NA	NA	NA	NA	NA	None supplied
Venture Capital Fund of New England 160 Federal St., 23rd floor Boston, MA 02110	Kevin J. Dougherty 617-439-4646	=	30	25	40	30	50	Progress Software, New Media Graphics, Microwave Modules & Devices
Venture Funding Group Intl. 49 West 12th St. New York, NY 10011	Allan E. Skora 212-691-9895	▲	9	6	7	4	NA	None supplied
Weiss, Peck & Greer 555 California St., #4760 San Francisco, CA 94104	Philip Greer Robert J. Loarie 415-622-6864	▲	66	34	43	21	72	Adaptec, Network Computing Devices, Four-Pi Systems
Wind Point Partners 1525 Howe St. Racine, WI 53403	James Forrest 414-631-4553	▲	95	12	50	8	126	In-Store Advertising, Power Trends, Effective Management Systems
Zero Stage Capital Co. One Broadway, 10th floor Cambridge, MA 02142	Gordon B. Baty 617-876-5355	=	26	18	33	22	40	Octocom Systems, Swan Technologies, Mercury Computer Systems

*▲increase, ▼decrease, =stay the same

Please note that this is not a complete listing of venture capitalists that serve the electronics industry, but a directory of those companies that chose to participate in our survey.

Canon challenges Nikon's lead in Korea

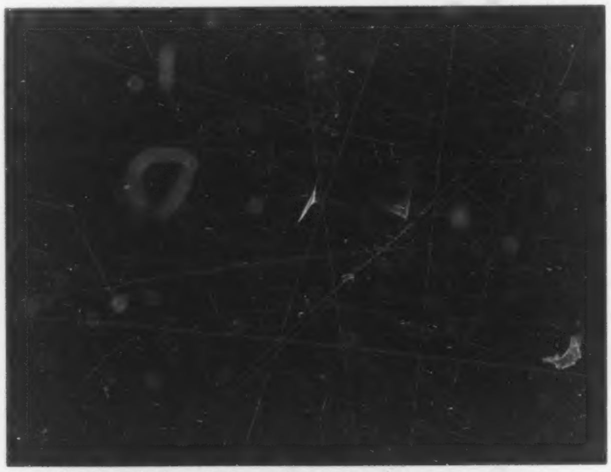
Nikon dominates the Korean stepper market, where DRAMs are king—but Taiwan's ASIC business is still wide open

BY RUSS ARENSMAN

Korea's largest semiconductor maker, Samsung Electronics Co., is one of the largest and most loyal customers of Japan's Nikon Corp. To date, Samsung has purchased about 100 Nikon stepping projection aligners, or steppers, which cost more than $1 million each and are used to project microscopic circuit patterns onto the silicon wafers Samsung uses to build its most complex dynamic random-access-memory (DRAM) chips.

Although Samsung officials say they are quite satisfied with the Nikon steppers and have no plans to switch their DRAM production to another vendor's machines, several of the newest steppers in the company's DRAM factories near Seoul were purchased from Nikon's archrival, Canon Corp. Samsung's engineers will spend the next year or more evaluating the latest offerings from the two Japanese companies, and by 1993 the company expects to select one vendor to supply dozens of additional steppers for its next chip factory, which will produce 16-megabit DRAMs.

Steppers are too important a part of the chipmaking process to let loyalty to a single vendor stand in the way of using the best possible equipment. So Samsung, like many other semiconductor manufacturers, must constantly keep abreast of the new equipment that is developed by the other vendors.



S. G. Warburg's Chuck Gote: Canon has become very aggressive recently

Competition is particularly aggressive in the stepper business, because suppliers who fall behind in technology development—or any aspect of quality control, marketing, service, or customer support—risk losing tens of millions of dollars with just a single order.

Presently considered the world's largest stepper company, Nikon has a commanding lead in the Korean—as well as the worldwide—stepper market. Industry officials estimate Nikon's market share in Korea to be close to 50%, with Canon in second place, having sold perhaps 30% of Korea's 500-plus steppers now in use. GCA Corp. and Ultratech Stepper—both subsidiaries of Stamford, Conn.-based General Signal Corp.—and Japan's Hitachi Ltd. share the relatively small portion of the market that remains.

"Korea has grown up on Nikon—it's a Nikon country," according to Bill Delaney, managing director of Intraco Asia, which sells and supports steppers from Netherlands-based ASM Lithography Inc. in Korea and Taiwan. He concedes that ASM Lithography's steppers have attracted only a few customers in Korea so far.

Depending on DRAMs

The main reason Nikon does so well in Korea (and its home market of Japan) is that Nikon's stepper business depends heavily on the DRAM industry, which is concentrated in Japan and, to a lesser degree, Korea. While Nikon steppers can be used to make other kinds of semiconductors, they have been optimized for high-volume memory chip production.

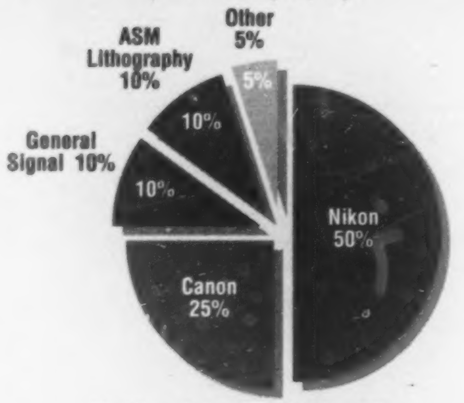
As a result, about 80% of the company's business comes from DRAM makers. "Korea has a tendency to buy what's selling well in Japan because Korea's strategy—like Japan's—is in DRAMs," according to G. Dan Hutcheson, president of VLSI Research Inc., a San Jose technology research firm.

But the situation is much different a few hundred miles to the south. There, in Taiwan, the stepper market is more evenly distributed, with ASM Lithography, Nikon, and Canon each possessing roughly 30% of market share. Most of the country's chip companies have avoided the cutthroat DRAM market and concentrated instead on building application-specific integrated circuits (ASICs), primarily for personal computers and telecom.

Despite their differences, both countries' chip industries have been grow-

Asian stepper market

(not including Japan)



Total market value: $160 million (about 13% of world market)

Source: VLSI Technology Inc.

ing rapidly, and the dozens of new chip plants constructed in Korea and Taiwan in recent years have provided a significant new market for semiconductor equipment vendors. Hutcheson estimates the Asian semiconductor fabrication industry outside of Japan, most of which is concentrated in Korea and Taiwan, purchased about $160 million, or 13%, of the world's $1.2 billion in steppers sold during 1989.

Equipment sales have been growing faster in the two countries than in Japan, he says, although preliminary figures for 1990 indicate their market growth rates may have slowed substantially last year. "The Koreans are trying to digest what they already bought," he says, while most of Taiwan's chip makers have put further expansion on hold while they scramble to find enough business to fill all the new chip factories built there during the past two years.

Only two Taiwanese companies—ASIC-maker Macronix International Co. and a DRAM joint venture between Acer Inc. and Texas Instruments Inc.—are building new plants that will require a substantial number of new steppers this year.

U.S.-based Vitelic Inc., which ran out of money to complete its new $115 million Taiwanese plant early this year, may also be buying steppers soon, following its recent agreement to merge with Taiwan's cash-rich Hualon Microelectronics Co.

In Korea, Goldstar Electron Co. is expected to make the only major purchase this year when it begins to equip a new 4-Mb DRAM production line.

Nikon versus the world

So Nikon clearly remains the leading stepper vendor, both in the Asian region and the rest of the world. But it no longer dominates the industry to the degree it used to. The Tokyo-based company sold 530 steppers in 1988, 460 in 1989, and was expected to sell even fewer during fiscal year 1990, which ended in March. One reason for the downturn was the 20% sales decline last year in the world DRAM market, which hit Nikon harder than other vendors. Another reason, however, was the strong competition Nikon has been facing from Canon and others.

"Last year Canon made a very aggressive move and started undercutting prices and increasing services," says Chuck Goto, a senior technology analyst with S. G. Warburg Securities (Japan) Ltd. in Tokyo. Hitachi, which used to make steppers mainly for its own internal use but has now begun to pursue outside customers, has also been quite successful, Goto says—especially in Japan, where it sold more than 100 units last year.

> **Steppers are too important to let vendor loyalty stand in the way of using the best equipment**

Although 1990 market statistics are still being compiled, they will undoubtedly show an increase in Canon's share of the stepper market. "Canon has started shipping a great deal to Korea," says Goto. At Samsung, for instance, company officials say that in addition to the 4 or 5 Canon steppers under evaluation for DRAM production, they have purchased about 15 Canon steppers for another operation that makes ASICs and linear chips for the company's electronics products.

S. E. Ju, director of Korea's Hyundai Electronics Industries Co.'s semiconductor division, says his company started out in the mid-1980s using U.S.-built steppers from Eaton Corp. and GCA. Since then, it has purchased most of its steppers from Nikon.

Most recently, Hyundai bought 20 Nikon steppers for its newest DRAM factory, which opened last spring and should reach its full production capacity of 20,000 6-inch DRAM wafers a month by midyear. But the company also bought and is evaluating a pair of Canon steppers, which could replace Nikon's in the company's next DRAM plant.

"There are three very strong vendors now, all of them in Japan," says Hee Gook Lee, executive director of Goldstar Electron. The company previously used a lot of U.S. steppers from GCA and Ultratech Stepper. But most of the 70 steppers the company has purchased in recent years have come from Canon and Hitachi, and a few from Nikon.

Performance and reliability

Goldstar Electron is Hitachi's only substantial customer in Korea so far, but Lee dismisses claims by rival stepper vendors that his company is being forced to use only Hitachi's steppers as part of its 1989 deal to acquire Hitachi's 1-Mb and 4-Mb DRAM production technology. "Hitachi, itself, uses a lot of Canon steppers," he says, adding that Goldstar Electron's criteria for selecting steppers is fairly simple: "We try to purchase the best performance machine."

Taiwan's largest chip company, United Microelectronics Corp., is using 10 steppers—4 from Ultratech and 6 from Canon—in its oldest manufacturing plant. In 1989 it purchased 17 Nikon steppers to equip its second plant. The company originally selected Canon to supply steppers for its second plant, but it switched to Nikon because of engi-

SEMI's director Chang-Ho Kim (left) and the organization's president, George Moore

neering problems with the Canon machines.

UMC executive vice president Ing-Dar Liu says the company is now evaluating steppers from Nikon, Canon, and ASM Lithography, although it isn't likely to make another large purchase until 1992. When it does, it will probably buy "i-line steppers," which produce circuit patterns with much thinner lines than mainstream "g-line" steppers. That would appear to give an advantage to ASM Lithography because their reputation in the industry has been in i-line technology.

But while ASM Lithography had an early lead in the technology, both Canon and Nikon are now offering i-line steppers of their own. Moreover, both Japanese companies' steppers have better reputations for reliability.

Taiwan Semiconductor Manufacturing Co., Taiwan's second-largest chip company, bought 10 Nikon steppers for its first manufacturing plant in 1987. But for the initial phase of its second plant, it bought 17 ASM Lithography steppers.

TSMC's vice president of operations F. C. Tseng admits that the ASM Lithography steppers have broken down or required service more often than the company's Nikon machines. He adds, however, that ASM Lithography's service staff has been vigilant and quick in performing repairs. Still, when asked about his criteria for selecting another 17 or 18 steppers for the next phase of the company's expansion in 1993, he says reliability will be a higher priority than price or performance.

"Sales, service, support, and reliability—those are often much more important factors than the technology," says VLSI analyst Hutcheson. He notes that Nikon, seldom known for being on the leading edge of new technologies such as i-line steppers, is nonetheless well-known for making machines that rarely break down. "They never introduce anything until it's bulletproof." Hutcheson says.

Hyundai's Ju says he thinks the performance and reliability of Canon and Nikon steppers are almost identical. He adds, though, that Canon's service is "excellent," and perhaps just a bit better than Nikon's.

Hiroshi Kato, Nikon's Asian sales and marketing manager, responds that his company is trying to recruit more people to strengthen the field service staff at its Korean office where it already employs about 30 people. Service is the key issue, he says, at least in terms of staying competitive with Canon.

UMC vice president Liu, on the other hand, isn't particularly interested in equipment suppliers' service capabilities. "If you have good reliability, you don't need service," he says, adding that reliability is his top criteria for selecting stepper equipment, followed by performance—better line resolution—and then price.

All other things being equal, Liu says, price can be an important deciding factor. In that particular category, he gives the best marks to Canon, adding that Nikon has been less willing to make concessions.

Goldstar Electron director Lee adds supplier longevity to the consideration list. The supplier should still be around in a few years offering support and spare parts, as well as new and improved equipment.

"Stability in the equipment manufacturer is perhaps the most important thing we like to see," Lee says, "and that is where the Japanese have an edge." He cites last year's sale of Perkin-Elmer Corp.'s lithography business as symptomatic of problems and uncertainty throughout the U.S. stepper industry.

U.S. makers come up short in the eyes of many Asian customers when all aspects of business stability, performance, reliability, and service are considered. "There simply isn't, as far as I know, a very attractive U.S. stepper company today," Lee says.

To be really successful, today's chip manufacturers "need to have it all," says Chang-Ho Kim, director of Korean operations for the trade association Semiconductor Equipment and Materials International, or SEMI. "In order to sell systems in Korea," he says, "you need to have the right price structure, service capability, and technology." Inevitably, he says, the vendor that offers the best combination of all those things will win the most orders.

Russ Arensman is a senior editor at Electronic Business Asia

Prices plummet in low-end laser printers

Bargains abound as vendors nibble away at Hewlett-Packard's lead by targeting market niches and offering enhanced functions

BY BARBARA JORGENSEN

With competition at the low end of the market putting an inexorable squeeze on prices, 1991 may be the year the laser printer replaces the dot-matrix on the desktops of the masses.

Lasers broke through the all-important $1,000 price point in 1990. During the past five months, Apple Computer Inc.—the number-two player in the market—and other vendors have been scrambling to meet an aggressive price challenge by Palo Alto-based market leader Hewlett-Packard Co., cutting prices in the hope of pushing boxes through reseller channels just to maintain market share.

"Competitors are trying to divide and conquer," observes Thad Webster, midrange product-line manager in HP's Boise, Id., printer division. "Customers are getting a great value out there." Activity is especially intense at the low end of the market, which most observers define as seven pages per minute (ppm) or less. Prices in that segment now range from $880 to $2,500.

One result of the competition is that the laser has begun to supplant the dot-matrix as the desktop printer of choice. According to market researcher InfoCorp, U.S. shipments of dot-matrix printers will plateau at 5.9 million units in 1991—a one-year increase of only 0.6%. By contrast, sales of desktop laser printers are expected to grow by 33% this year.

There are several reasons for that growth. One, of course, is falling prices, which are largely due to inexpensive Japanese "engines" and lower-cost memory. Another is the acceptance of slower printer speeds. Still another is the growing recognition of the devices' commodity status, at least at the low end. That moves them from the shared-resource to the "personal" environment, where the ratio of PCs/workstations to printers is 1:1, according to market researcher BIS Strategic Decisions. "The potential exists for thousands of personal workstation locations within *Fortune* 1000 companies," says a BIS source.

Price wars

There's little doubt that the price war is being led by HP, which recently slashed its LaserJet IIP by 14%. "If you position yourself against HP, you have to do it on price," says analyst Dan Miller at Dataquest Inc. In the under-6-ppm desktop market, InfoCorp expects an overall 7% drop in prices this year. But even higher-end lasers are vulnerable: InfoCorp predicts a 7% drop in the 7-ppm to 14-ppm group and a whopping 14.3% drop in the up-to-24-ppm market.

Several developments during early 1991 tell the story. In January Mannesmann Tally Corp. cut its MT906 laser's price by $500, and Epson America Inc. announced the 6-ppm EPL-7000 for a suggested retail of $1,399. In February Texas Instruments Inc. cut the prices of its MicroLaser family by $350. And in March Apple introduced the $1,299 Personal LaserWriter LS and cut prices on its three higher-performance LaserWriters by up to 21%, while Packard Bell's $1,995 8-ppm PB9815 fell to below $900.

The battle of the pricetags has led to fundamental changes in marketing and sales strategies. Toshiba America, for example, has dropped its high-end PageLaser 12 in favor of the PageLaser 6, to compete on the low end with other 4-ppm to 8-ppm vendors. And Apple recently broke the $2,000 barrier for the first time with its Personal LaserWriter LS—a move some analysts see as an attempt to stem the flow of other vendors niching into the Macintosh environment.

Sales channels are expected to change along with prices. The shift from traditional computer resellers to superstores and consumer electronics stores should accelerate this year, driving prices even lower. The street price of a 4-ppm laser could break $700, say analysts.

"My suspicion is the reseller isn't making any money," says Angele Boyd, analyst for International Data Corp., "but with prices dropping,

Printer price trends in 1991

(unit cost)

Make/Model	1990	1991	% Change
9-pin serial dot matrix	$ 398	$ 386	-3.0%
24-pin serial dot matrix	664	605	-8.9%
Under 6-ppm* desktop laser	945	879	-7.0%
7- to 14-ppm desktop laser	2,087	1,941	-7.0%
15- to 24-ppm workgroup laser	7,394	6,338	-14.3%
Desktop thermal transfer	5,906	5,292	-10.2%
Serial ink jet	681	643	-5.6%

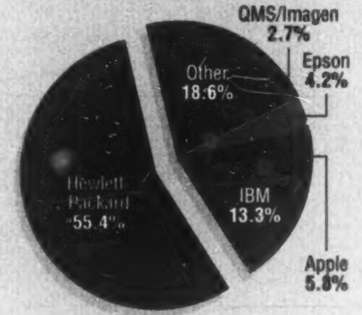
*page per minute

Source: InfoCorp

there are new reseller channels popping up—superstores and mail order, for example. Those stores aren't working on margins, they're just moving boxes." In today's environment, she adds, computer resellers who have charged for value-added services simply can no longer justify their traditional margins.

HP leads the pack

U.S. unit market share of 4- to 6-ppm laser printers in 1990



Total units: 591,800

'Other' includes Okidata, Texas Instruments, NEC, Panasonic, among others.

Source: InfoCorp

Taking on the kingpin

The top two players in the low-end have been pretty consistent since Apple first gave kingpin HP a run for its money in 1985. The reason, say analysts, is that the companies have been able to offer upgraded products with enhanced features and gradually decreasing prices. Both Dataquest and BIS list the companies as market-share leaders but decline to release specific share numbers. InfoCorp, however, which *does* release market share figures, lists IBM (through its Lexmark operation) as the number-two player. Differences in gathering data account for the disparities.

Either way, analysts and vendors agree that HP still rules the low end, largely by spanning the market with its LaserJet family. As it dominates that segment, other vendors have tried to compete wherever HP isn't. While HP generally sells through the national reseller chains, for example, others (including Toshiba) are geared toward mass merchants, notes Ron Matheson, Toshiba's director of marketing for printer products.

To compete with HP, major vendors have all tried to carve out a market share on the basis of price, niche, added value, and ease of use. Panasonic resellers, for example, are going after bar code applications in the consumer hard goods distribution market. Mannesmann Tally has tried to out-niche HP by introducing a fast-processing laser, priced at $2,195, for publishing and other tasks, says spokesperson R. Bruce Ridley. "We were able to process jobs faster than the 8-ppm to 10-ppm printer," he adds, "but all [the resellers]wanted to talk about was price." But QMS Inc. has stuck to its price guns—the 4-ppm PS410, $2,795, is selling "extremely well," a spokesperson says.

TI is taking on HP's LaserJet Series III with its MicroLaser. The key is to differentiate the company and the product, says Aubrey Brickhouse, TI's marketing manager for printer products. In this case, the difference is a smaller and lighter machine; as a result, Brickhouse claims, the company is becoming a larger factor in the low end. "We have gained some market share and are doing well," he reports. And while HP's channels are dealer-direct, TI gets to dealers through wholesalers. "In general, people that sell TI products are happy with their margins," says Brickhouse. In fact, say InfoCorp sources, TI and IBM have grown into significant factors in low-end lasers during the past few years. Together, the two companies now hold about 15% of the market.

In fact, the division that won IBM its market share will now be giving competitors a run for their money under its own logo—Lexmark. At the end of March, Lexmark International Inc. was formed through the sale of IBM's information products business for organization by Clayton and Dubliler Inc. An IBM alliance company (IBM still has 10% equity interest), Lexmark now has a sales force dedicated solely to Lexmark products. "We're gaining share slowly but steadily," says spokesperson Jim Gleason. "We intend to focus on service, our users, and our dealers."

Printers are inextricably linked to PCs, and HP and Apple have decided to sell through their PC channels. Apple has tightened the printer-PC bond, in fact, since the Personal LaserWriter LS is very limited unless linked to a Macintosh.

In the case of the LS, the company was told by focus groups that laser printers were too complex and had too many controls and add-ons. As a result, unlike its "smart" competitors in the low end, the LS doesn't have a microprocessor. "It has a power switch," says Duane Schulz, Apple's printer product-line manager. "You turn it on, paper comes out, and you turn it off." The smarts for the printer are all in the Mac. The QuickDraw program allows font types and sizing comparable to the more expensive Adobe PostScript page description language or Hewlett-Packard's PCL.

"We're not in the printer business for the sake of being in the printer business," says Schulz. "We want to deliver complete systems."

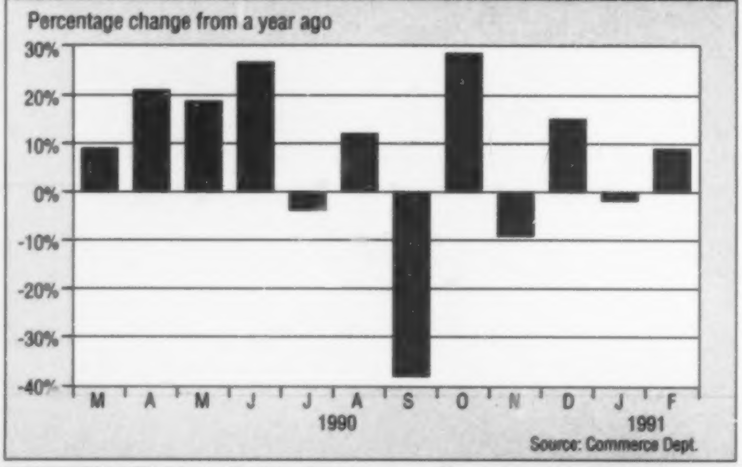
But, InfoCorp notes, nothing lasts forever. IBM, through Lexmark, and Panasonic have been making inroads. "Few resellers feel they're making money on the HP LaserJet," says Ed Pullen, analyst with InfoCorp. "The strategy to gain dealer attention is to add value, not cut price. One example is Star Micronics's promotion of offering 151 fonts free with its Star LaserPrinter4."

IDC analyst Boyd notes, though, that HP has long been responding to the dynamics of the market (witness the entrance of HP's IIIP). "HP is not an arrogant vendor," Boyd says. "Apple and IBM priced their products higher than other parties but felt it was justified. They were slow to respond to market pressure."

Boyd points out that most vendors offering low-end entries also have machines at the high end, offsetting the low end's extreme pressure. "The margin pressure," she says, "is a dynamic evidenced over the past few years, forcing vendors to move more carefully—and push many boxes." HP, for example, has kicked off the $5,495 LaserJet IIISi, the company's first RISC-based offering, while the $1,595 IIIP addresses some resolution and power issues in a smaller package.

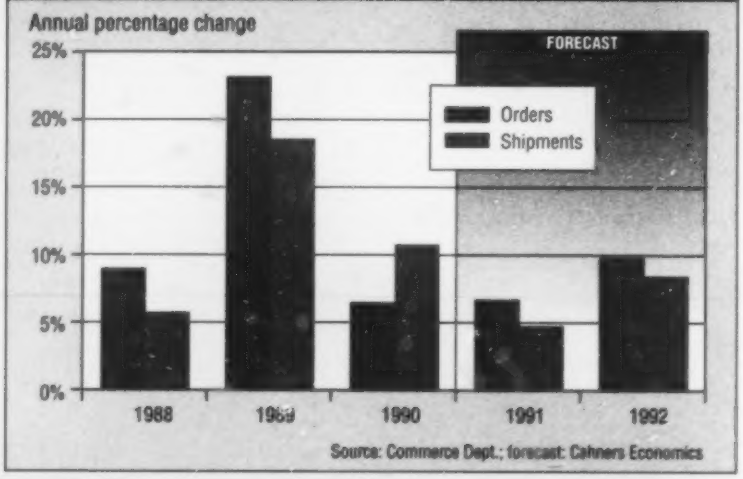
As for an expected low-end shakeout, HP's Webster isn't chortling yet. "I guess it's too early to call it a victory," he says, "but our business continues to be good. In the low end, we think we're going to survive because we're bringing success to the other areas. Survival is not a matter of price. There's a finite level and a number you can operate with. It's a marathon, not a sprint." ☐

Rough ride for communication equipment orders...



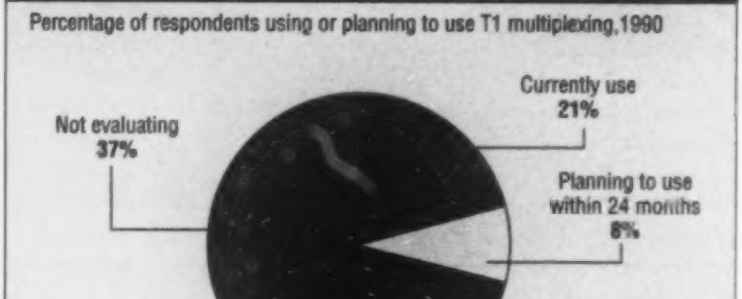
Source: Commerce Dept.

...but healthy growth is forecast for future...



Source: Commerce Dept.; forecast: Cahners Economics

...as users switch to new technology



Source: Business Research Group

Communication equipment sees rekindling

As the Persian Gulf War escalated, the communications equipment industry suffered quite a beating. However, with business confidence again on a more even keel, the information explosion is rekindling demand for equipment such as local area networks, voice messaging systems, and digital switches. So telephone and data communications orders and shipments will enjoy relatively healthy growth despite the recession.

During the first half of last year, billings for telephone gear, facsimile machines, multiplexers, and other communications equipment swelled 17.9% from the year-ago period. By contrast, in the final six months of 1990, orders dropped 2.8% from the second half of 1989. Clearly, fears of a prolonged Middle East conflict and deepening economic woes at home squelched capital spending plans, even for high-tech gadgetry.

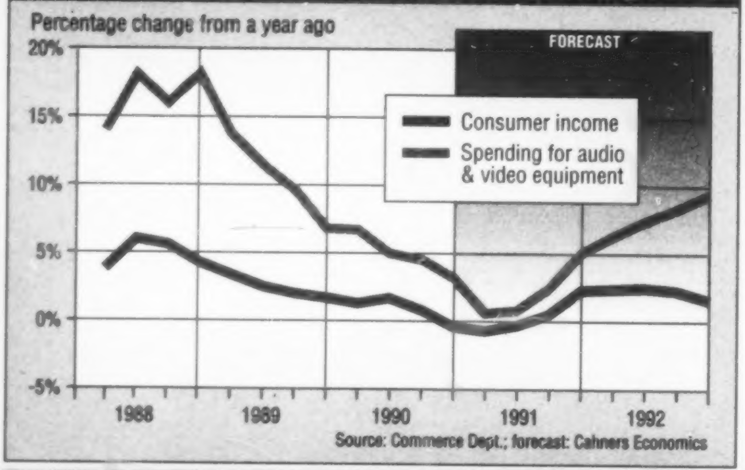
The communications equipment industry is showing initial signs of breaking away from the recession. In February, orders grew 21.5% from January and 9% from the strong showing of February 1990. The industry should anticipate some setbacks; full-fledged resumption of stronger growth is not expected until a little later this year. New orders are forecast to grow 6.7% this year and 9.8% in 1992.

Since they encourage productivity, many communications equipment markets will enjoy above-average growth. Businesses will invest in enabling technology as part of their competitive strategy. For example, in a recent survey of information systems managers, Business Research Group, a Newton, Mass., consulting firm, found that 21% of respondents currently used fractional T1 multiplexing, another 15% plan to use this technology within the next 12 months to 24 months, and 27% are currently evaluating the technology. The growth in T1 fractional lines translates into the need for equipment with fractional capability. BRG predicts that sales of multiplexers equipped for fractional T1 will more than double from $32 million in 1990 to $77 million in 1993.

MADELINE FRANCHI

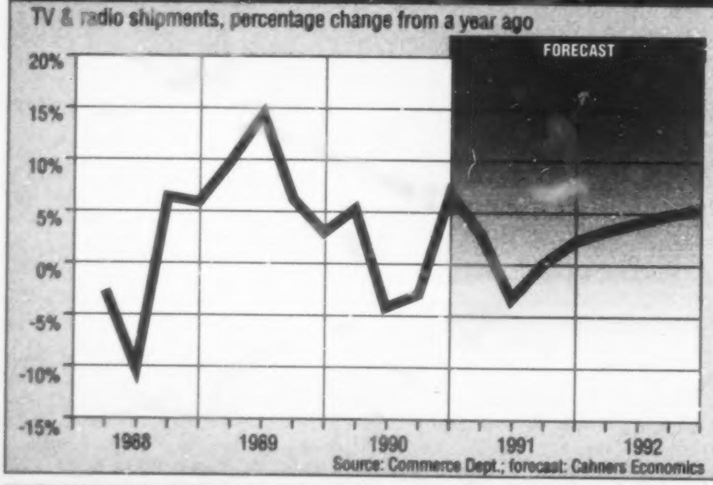
Note: With the release of February data, the U.S. Department of Commerce revised all shipments and orders data consistent with the 1987 Standard Industrial Classification codes. Search, detection, and navigation equipment formerly classified as communication equipment has been shifted to instruments and related products. All historical data and forecasts have been revised accordingly.

Slow income growth drags consumer spending...



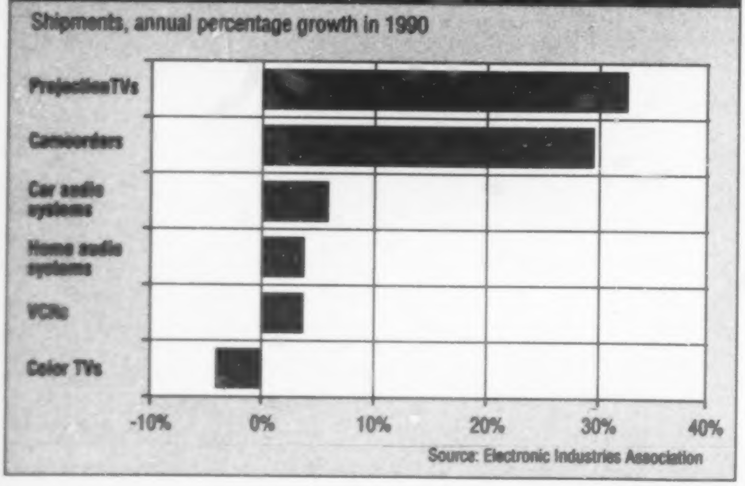
Source: Commerce Dept.; forecast: Cahners Economics

...and dampens consumer electronics shipments...



Source: Commerce Dept.; forecast: Cahners Economics

...but new products will keep going strong



Source: Electronic Industries Association

Consumer electronics defies recession woes

The consumer market has taken a number of hard hits lately. Consumer confidence fell in January to its lowest level since 1982. Disposable personal income increased just 0.9% last year, after adjustment for inflation. Unemployment rose to 6.8% in March. All of this suggests that the consumer electronics market should be suffering a period of despair. In fact, sales have remained relatively strong.

Spending for consumer audio and video equipment jumped 4.8% in 1990. Although historically slow for the industry, that growth rate outstripped the 0.9% gain seen for all consumer purchases. Shipments of television and radio equipment fell 4.2% in the second quarter and 2.9% in the third quarter of 1990 compared with a year earlier; but as the rest of the economy entered a recession, sales climbed 6.9% in the fourth quarter. This trend continued into 1991, with January sales soaring 25.2% above January 1990.

Sales data from the Electronic Industries Association reveals the biggest product gainers were projection TVs—which climbed 32.5% in 1990—and camcorders, which rose 29.5%. In addition, audio components and systems grew at a moderate 3.8% rate, and automobile audio equipment rose 5.9%. The color TV market also revealed better conditions than expected by falling only 4.1%, after a record-high sales figure in 1989.

Because of the recession, consumers have deferred spending for big-ticket items such as cars and vacations in favor of less expensive purchases such as home entertainment systems. Retailers are eagerly awaiting a return to double-digit sales growth like that of the late 1980s.

However, mounting consumer debt, which totaled $740 billion at the end of 1990, will impede higher spending in the near future. Disposable income is also expected to inch up only 0.5% in 1991. As a result, our forecast calls for a mild 2.2% rise in consumer spending on TV and radio equipment in 1991.

JOHN FARRELL

For more information on Cahners Economics' forecasting services, including seminars, newsletters, and database diskettes, contact Dan Buchan at (617) 630-2105 or by fax at (617) 630-2100; or write Cahners Economics, 275 Washington St., Newton, MA 02158

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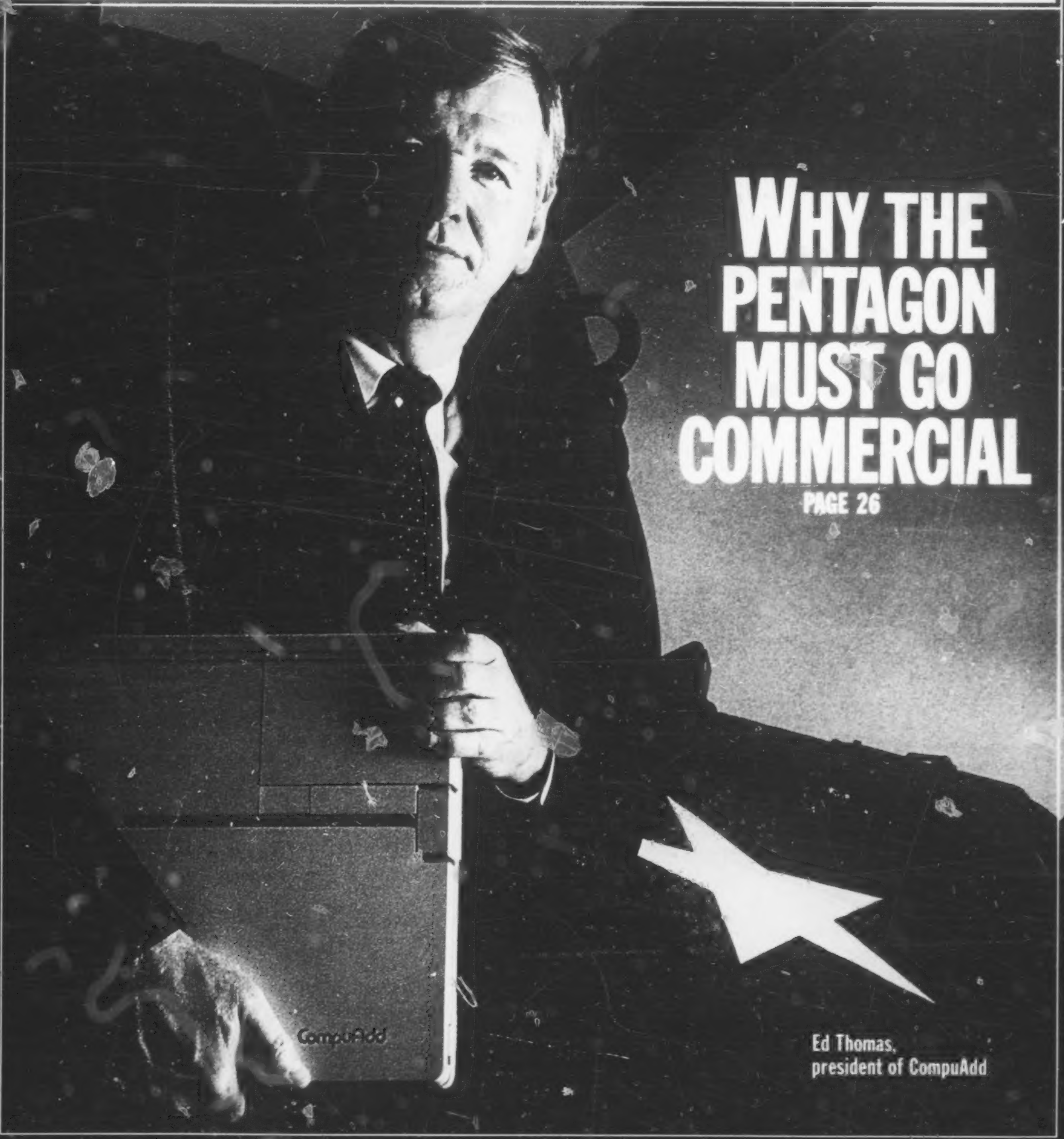
JUNE 3, 1991



WHY THE PENTAGON MUST GO COMMERCIAL

PAGE 26

Ed Thomas,
president of CompuAdd

Electronic Business

FOR THE MANAGEMENT TEAM IN ELECTRONICS, COMPUTER, AND SYSTEMS COMPANIES—WORLDWIDE

VOLUME 17, NUMBER 11

JUNE 3, 1991

Cover: Zigy Kaluzny

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The Persian Gulf war may have been a turning point for the U.S. military and for the U.S. electronics industry. The reason: a shrinking defense budget that will increasingly force the military to look to off-the-shelf electronics—which proved more than satisfactory during the Gulf conflict—rather than the pricier mil-spec versions. Now the industry wonders whether the Pentagon can change its traditional way of doing business

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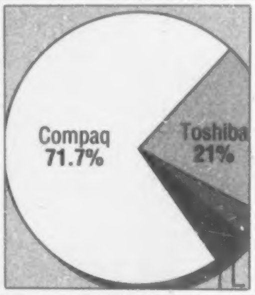

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INSIDE BUSINESS

Quality-conscious suppliers may reap "defense dividend"

Art director Michael Roach: a new look for a new era

WHEN THREE important trends synchronize, look for a major shift in the marketplace. That's what is happening as total quality management, shrinking defense spending, and changing military strategies all meet in the U.S. electronics market.

Throughout the course of the Gulf war, ELECTRONIC BUSINESS has chronicled the success of computer-based weapon systems. It has also forecast the growing importance of electronically driven surveillance, communications, and intelligence systems in the post-Cold War era.

And it's no secret that Pentagon budgets face continued pressure. Only seven months ago, the Electronic Industries Association predicted that the defense budget will shrink by nearly one-third by the end of the century, and that annual expenditures for defense electronics will plummet from more than $55 billion last year to $38 billion by the year 2000. One major military victory later, defense analysts still look for double-digit budget cuts over the next five years, with resulting pressure on the Pentagon to streamline its procurement bureaucracy.

Total quality management is a theme we've been hammering on for years, and apparently OEMs have gotten the message. Forced to turn to commercial suppliers to feed its intense need for computers and other electronics systems in the Gulf, the Pentagon found out that these products measured up admirably to the much-vaunted "mil-spec" requirements for toughness and reliability. As associate editor Peter Burrows reports, it's no accident that a commercially supplied personal computer survived a Scud missile explosion that hurled it 50 feet through the air. With that kind of anecdotal evidence, Peter reports, it's getting easier to promote the use of commercial technology by the military.

As you can see by paging through this issue, today's new look goes far beyond defense spending. Thanks to art director Mike Roach, the design of ELECTRONIC BUSINESS itself has been overhauled to reflect the changing tastes and demands of our readers. Throughout the magazine, you'll notice that we're now a little more reader-friendly—the copy is a bit less dense, the artwork brighter and easier to understand.

But if it doesn't work for you, then it doesn't work for us either. Drop us a line and tell us what you think.

—John Parker, contributing editor

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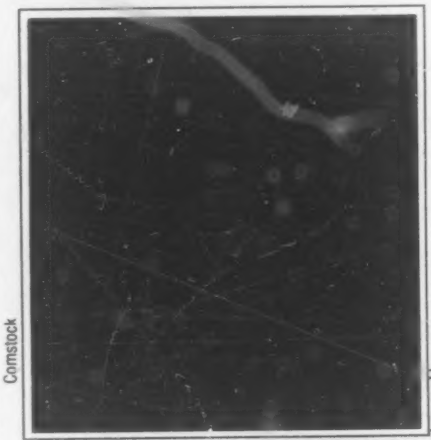
TRADE

Industry backs free trade pact


Comstock

WHEN PRESIDENT Bush recently alluded to the creation of "the largest, richest trade zone on earth," he wasn't thinking about the single European market of 1992. Rather, he was referring to the proposed North American free trade agreement (FTA), which would merge Mexico, the United States, and Canada into a single market much larger than the European Community.

The administration clearly hopes to make FTA a reality, and U.S. electronics companies have been vocal in their support. For the $280 billion U.S. electronics industry, the impact of adding Mexico to the 1988 Canadian-U.S. trade alliance will be minor; the size of the U.S industry makes Mexico's electronics contribution—$6.5 billion, or 2% of the U.S. industry—seem like a drop in the bucket.

For individual U.S. interest groups, however, FTA's impact will be far from minor. Clearly among the winners will be U.S. electronics companies with deep pockets to invest in an emerging country. U.S. companies have already taken advantage of proximity, low wage rates, and special tax incentives to build *maquiladoras*, production plants on Mexico's border. A free trade agreement would make Mexico even safer for direct foreign investment. General Motors (whose electronic divisions include Packard Electric, GM Hughes Electronics, and Delco Electronics), AT&T, Zenith Electronics, United Technologies, and Eastman Kodak have all announced their support for FTA.

The most heated opposition to FTA comes from U.S. labor unions. The reason: Unskilled laborers, who are paid an average of $14.32 an hour in the United States, will lose jobs to *maquiladora* laborers who get just $1.63 an hour. Exactly how many jobs will migrate south of the border under FTA remains the subject of debate among consultants. KPMG Peat Marwick's study done for the U.S. Council of the Mexico-U.S. Business Committee estimates that less than 1% of U.S. electronics workers will lose their jobs to Mexican laborers.

U.S. labor may fare better than it supposes, if moving jobs to Mexico simply replaces moving jobs to low-wage Asian countries. In effect, every plant that moves to Mexico rather than Asia is that much closer to U.S. supply lines, which saves jobs at supplier plants. But while this argument may appeal to U.S. business owners, labor unions aren't buying it. For labor, the mission is to stem the flood of well-paying factory jobs that are leaving the United States and to fervently oppose FTA.

The administration's push for a North American trade agreement with Mexico comes on the heels of several years of astounding export success. According to the Electronic Industries Association, the United States exported $5 billion of electronics products to Mexico in 1990, up 32% from 1988. Most experts agree that since a free trade pact will help the Mexican economy grow, electronics exports will grow even faster under the agreement. As a developing country, Mexico's appetite for high-tech products (particularly telecommunications equipment) will be voracious. Under a North American FTA, the United States and Canada will have the inside track to provide these goods.

The odds seem to be in favor of the North American free trade agreement. So, while Fortress Europe is being erected for 1992, it seems that Fortress North America is preparing to retaliate.

—Elizabeth B. Baatz

Jobs and free trade

Change in domestic employment

	Computers	Components	Instruments
U.S.			
employment	-2,700	-4,700	11,400
% change	-0.7%	-0.8%	0.9%
Mexico			
employment	2,400	15,100	7,000
% change	9.1%	16.2%	9.4%

Note: Data represents employment change in 1988 if there had been a free trade agreement in effect.

Source: KPMG Peat Marwick, Feb. 1991

IC PRODUCTION

Submicron capacity on the rise

THE U.S. SEMICONDUCTOR industry continues to push into the submicron realm. The latest ground was broken by Motorola Inc.'s new fab in Austin, which features 0.35-micron geometry. Located near the stomping grounds of Sematech, the new half-billion-dollar fab is stocked with the latest equipment, more than 80% of which came from American suppliers. Only 2%

of the construction fees went to non-American companies.

Motorola's Semiconductor Products Sector brought in $3.4 billion in sales in 1990 and is ranked by market researcher Dataquest Inc. as the world's fourth-largest semiconductor maker. The plant, called MOS 11, represents Motorola's largest investment ever. The fab is the first commercial 8-inch wafer fab in the United States and combines CMOS and BiCMOS capability.

Other companies are also planning for low submicron geometry. AT&T Microelectronics and NEC Corp., which topped Dataquest's worldwide semiconductor company ranking in 1990, recently announced plans to collaborate on a 0.35-micron CMOS process. That process will be ready for manufacturing by 1995.

—Teri Sprackland

PORTABLE COMPUTING

Powerful computing comes to the palm

EVEN AS ANALYSTS predict a price bloodbath in notebook computers, Hewlett-Packard Co. has debuted the HP 95LX, the company's checkbook-size palmtop offering. The introduction, however, comes amidst limited success by other vendors—notably Atari Corp. and Poqet Inc.—in bringing palmtops to the masses. Atari and Poqet, in fact, have recently slashed prices on their palmtops by 25%.

The 95LX, probably the worst-kept secret in computerdom, was jointly unveiled in late April by HP CEO John Young and Lotus Development Corp. CEO Jim Manzi. While the tiny XT-compatible gets high marks for its big memory offerings, analysts say it's still too early to gauge the 95LX's impact on the poorly defined palmtop market.

"It's actually more personal than a PC," observes Computer Intelligence analyst Dan Ness, noting that the 95LX incorporates the handiness of personal organizers (such as Sharp's Wizard and Casio's BOSS) with Release 2.2 of Lotus's 1-2-3 spreadsheet, Microsoft's MS-DOS 3.22, and 1 megabyte of ROM. "Its spreadsheet orientation will have broad appeal," predicts Ness. "But it is *not* a PC replacement."

Lotus's CEO Jim Manzi: unveils one of the worst-kept secrets in computers

But what some analysts find most significant is HP's strategy in designing the 95LX: a computer, calculator, memo editor, scheduler, communications program, and file manager for $699. Organizers such as Sharp's peak at around $300, and the low end of the laptop/notebook market is near $1,000. The LX's strength in calculating is not coincidental; perhaps seeing the writing on the wall, HP chose its Corvalis, Ore., calculator division to build it. "It's going to open some doors for palmtops that weren't even there before," Ness predicts.

Although the 95LX is limited by its tiny keyboard, Ness believes it will appeal to numbers-oriented users. "HP usually goes for the more demanding, scientific [user]," he says. "It's the kind of reputation and relationship that HP has maintained throughout all its products."

Another feature that hasn't received much attention is the infrared communications capability, which makes transferring data from one 95LX to another as easy as using a TV remote. One 95LX can communicate with another via a built-in infrared link, or with the rest of the world with a serial port and cable.

Finally, HP has adhered to standards (such as its JEIDA RAM card) that will ensure interoperability and long life for the 95LX. "This will become more important over the years," says Ness. "People will be able to carry around a significant amount of information."

HP sees an obvious market among students and financial, sales, and real estate professionals. That doesn't include 1-2-3 users who'd love to have one for the road.

—Steve Smith & Barbara Jorgensen

FDDI SOLUTIONS

Motorola joins FDDI fray with new chip set

THE PROSPECTS FOR lower-cost FDDI connections brightened recently as Motorola Inc. introduced a chip set for implementing the 100-megabit-per-second network—the third IC solution to reach the market.

Even though Advanced Micro Devices Inc. of Sunnyvale, Calif., and National Semiconductor Corp. of Santa Clara, Calif., already sell chip sets for the Fiber Distributed Data Interface, analysts believe Motorola's product will catalyze faster price reductions for the chips and the products that incorporate them. Most believe, however, that it will take some time for prices to drop. "I don't think this will be the year of dramatic price cuts," says Marty Palka, Dataquest Inc.'s senior industry analyst for networks. In the near term, he says, manufacturers of FDDI products will focus on improving the performance of the connections, which will keep prices fairly high.

Cards to link PCs to FDDI networks now cost about $4,000 to $5,000, while cards for more sophisticated computers and workstations often run more than $10,000.

By next year, though, FDDI interconnection costs could begin to tumble. Connection costs for PCs should reach the $1,000-to-$1,500 range by 1993, Palka predicts, which will be inexpensive enough to bring the fiber network to many corporate desktops.

Pricing aside, Motorola claims its FDDI chip set, produced by the company's Microprocessor Products Group in Austin, offers better performance than its AMD and National Semiconductor counterparts, in part by containing two 32-bit ports for streamlining data transfers. The chip set was developed in association with Digital Equipment Corp. of Maynard, Mass., which is also one of Motorola's first customers.

—Dwight B. Davis

DAT DRIVES

Crowds are thinning in DAT market

NOT TOO LONG ago, observers predicted that some 30-odd producers would by now have emerged in the digital audio tape (DAT) drive market. So far, the actual number has hit only six. That suggests that the field may not become as crowded or unprofitable as once feared.

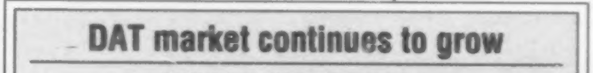
To date, the only OEM drive manufacturers shipping products in volume are Archive Corp., Hewlett-Packard Co., WangDAT Inc., Wangtek Inc., GigaTape GmbH, Alps Electric Co., and Sony Corp.; Japan's JVC Information Products division and two American companies (R-Byte Inc. and Alliance Technology Inc.) are expected to be shipping in volume by mid-year. Other early contenders—mostly Japanese vendors that presumed to leverage and capitalize on volume sales of consumer audio tape decks—have either fallen by the wayside or are still struggling to get evaluation units of computer data-grade drives out the door.

In the meantime, the lucrative OEM system design-in window is open. But it won't stay that way for long. OEM systems vendors such as Sun Microsystems Inc., Compaq Computer Corp., and Data General Corp. are all evaluating the latest 3.5-inch form factor DAT drives, and vendors who offer both evaluation units and production capacity will corral the business. "You can expect that a dozen will survive," according to Data Storage Concepts president Lee Elizer. "There certainly won't be 30."

There is still room for latecomers such as R-Byte, a San Jose-based 1989 start-up that has some impressive venture backing and is touting a made-in-the-U.S.A. image. "It's an important point for [system OEMs]," says R-Byte vice president of sales and marketing Gerald Boudreau. "American companies tend to buy American, and the rest of the field is either Japanese or relies on Japanese technology for its products."

—Dave Webb

DAT market continues to grow



Source: Data Storage Concepts

TECHNOLOGY

Moving on-line to move computers

PERHAPS IT SHOULD have happened a long time ago, but computer resellers are finally using the technology they market to run their businesses more efficiently.

Major computer distributors and retail chains are taking their reseller customers on-line with new and sophisticated database software that provides the latest prices and technical specifications for each system. The data is updated weekly or even daily via modem. The software can track a reseller's discount history with a particular customer, print out sales proposals in minutes, and even price a complex array of equipment on the basis of a specific profit margin.

Use of this kind of leading-edge sales tool is growing, says analyst Susan Yamada at Merrin Information Systems. "Of course, they have to carefully select the customers who buy the system because it's expensive," she says. "But there's a definite competitive advantage to these kinds of products. It's cheaper to place orders, they cut down on errors, and they tie the reseller tightly to the distributor."

Ingram Micro Inc., for one, has sold its System Quote database to 271 customers in the first three months of this year, with a target of 350 installations for the year. Installation of System Quote runs at around $1,995.

And many think this is the way business eventually will be done. "I've got to believe most of the business, five years out, will be electronically driven," says Merisel Inc.'s national accounts vice president, Judy Rosethshe. Merisel's Dialup Salesnet and Remote Salesnet let resellers access price and product data from the Merisel mainframe, but don't yet feature quotation or margin calculation.

Computer chains are getting into the act as well. Valcom Inc. is beta-testing an on-line system that can be updated nightly, and MicroAge computer store owners such as Tony Rametra can even crossload the latest MicroAge prices from the chain's ZData system to the System Quote database.

Such compatibility is part of Ingram Micro's overall strategy, says Barry Torman, president of Information Science Associates in Chicago and the creator of System Quote. System Quote users can access information on other distributors' product lines as well. Torman says Ingram Micro wanted to avoid the chaos that befell early airline reservation software, which was proprietary and limited to one carrier's flights.

—John Parker

STANDARDS

OSF makes gains on Sun's standards

INDUSTRY PUNDITS predict that the Open Software Foundation's Distributed Computing Environment will win out over competing technology from Sun Microsystems Inc. and Unix International. Widespread acceptance of DCE would be another blow to Sun's efforts to set industry standards.

Forrester Research Inc. in Cambridge, Mass., expects DCE (a set of specifications for sharing applications across computer networks) to overtake by the mid-1990s the Open Network Computing technology backed by Sun and UI. Specifically, unit shipments of the DCE remote procedure call technology will surpass the Sun/UI technology in 1995. A year later, shipments of the DCE distributed file system will exceed those of Sun's Network File System, a critical component of ONC.

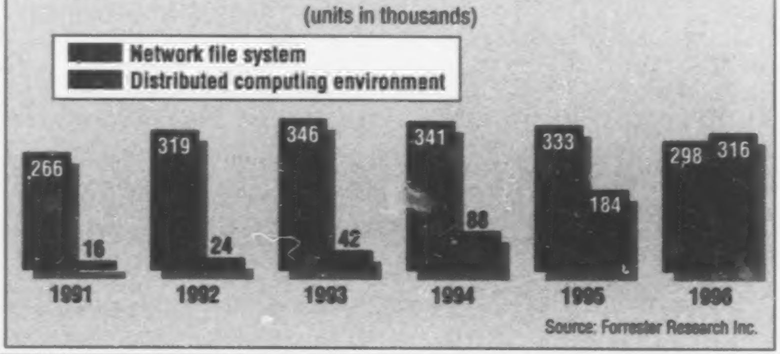
"Politically, Sun has been pretty inept setting standards in the last three years," says Forrester analyst John C. McCarthy, who believes Sun has focused so much effort on making its Sparc RISC architecture a microprocessor standard that software such as ONC and the Network Windowing System has languished.

DCE received a major boost in April, when Compaq Computer Corp. and other founders of the ACE (Advanced Computing Environment) consortium endorsed DCE as part of the group's proposed specifications for an industry-standard workstation platform.

"Any doubts regarding whether DCE will emerge as the dominant multivendor computing environment should be laid to rest," wrote UBS Securities Inc. analyst Marc Schulman in a recent report.

As proof of DCE's expected success, observers cite the number of industry heavyweights backing the proposed standard. Supporters include Compaq, Digital Equipment Corp., Microsoft Inc., IBM, and Hewlett-Packard Co. ACE is widely seen as a move to slow Sun's growth in the workstation arena, while OSF was intended to blunt Sun's ability to establish industry standards.

—Rick Whiting



Source: Forrester Research Inc.

QUALITY

106 companies apply for Baldrige

THE NATIONAL INSTITUTE of Standards and Technology has announced that 106 U.S. companies have applied for the 1991 Malcolm Baldrige National Quality Award, the largest number since the award was created in 1987, including 38 manufacturers, 21 service companies, and 47 small businesses.

Last year, only 4 of the 97 applicants received the award: IBM's Rochester (Minn.) unit and GM's Cadillac Motor Car Division in manufacturing, Federal Express Corp. in service, and Houston-based Wallace Co. in the small-business category.

If the past is an indication, only a handful of applicants are likely to pass the initial screening and receive site visits. In the manufacturing category (which encompasses most electronics companies), the number of site visits has steadily declined, from 10 in 1988 to 6 last year.

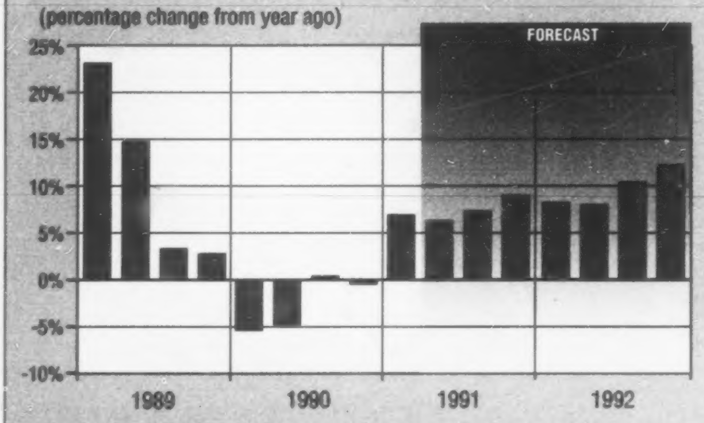
The Baldrige criteria have changed steadily since the inception of the award. Among the changes from last year's guidelines:

- Greater weight will be placed on customer relationship management;
- The educational value of the exam and scoring system will encourage training and self-assessment;
- Applicants will be required to be more specific about methods, processes, and results.

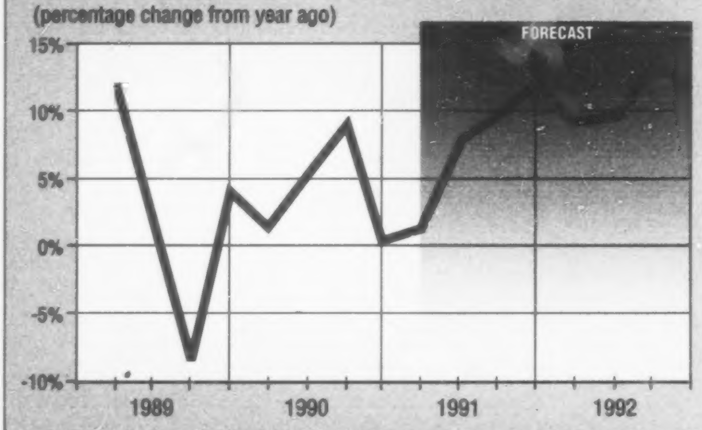
Named for the late Commerce Secretary, the Baldrige Award is intended to promote national awareness of the importance of quality. This year's winners will be announced in the fall.

—Barbara Jorgensen

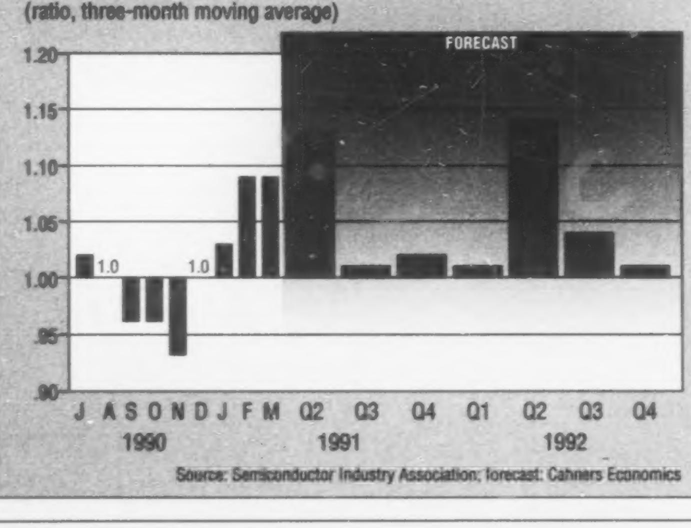
Semiconductor sales swell in the first quarter...



...while orders rebound at the same time...



...keeping the book-to-bill ratio above 1.00



Source: Semiconductor Industry Association; forecast: Cahners Economics

Surprise! Semiconductor orders up in early 1991

YES, SEMICONDUCTOR sales to the North American market did indeed suffer last year. Compared with year-ago levels, sales declined in every quarter last year except the third. Sales in that period squeaked out a meager 0.5% gain.

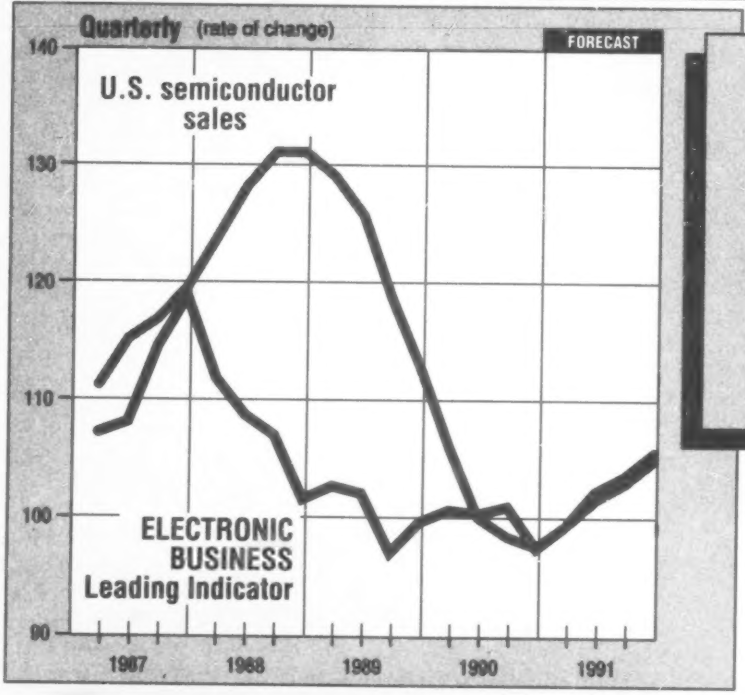
But the surprising news from the Semiconductor Industry Association may mean the semiconductor slump is over. Semiconductor sales to the North American market finally rebounded in the first quarter of this year, jumping 7% above year-ago levels to $3.74 billion. The last time the industry had a quarterly gain of this magnitude was in the second quarter of 1989. Because Cahners Economics had been expecting semiconductor sales to rise only 3% in the first quarter, we have raised our forecasts slightly for this year, which has stolen some growth from 1992. Semiconductor sales are now forecast to climb 7.5% to $15.5 billion this year and push up 9.9% next year.

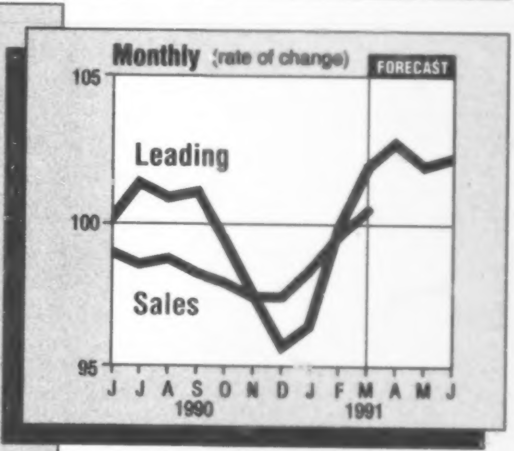
The fact that the Gulf war crisis led the semiconductor industry into the abyss of recession shows up clearly in growth of semiconductor orders. After expanding 10% in August 1990 from the year-ago period, monthly growth in orders shriveled through the beginning of this year. But with the end of the war came some renewed demand. New orders rose 1.5% to $3.82 billion in the first quarter of this year. Cahners Economics' outlook calls for continued strong orders growth, beginning in the second quarter.

—Julie Handelman

For more information on Cahners Economics' forecasting services, including seminars, newsletters, and database diskettes, contact Dan Buchan at (617) 630-2105, by fax at (617) 630-2100, or write Cahners Economics, 275 Washington St., Newton, MA 02158

ELECTRONIC BUSINESS Leading Indicator rises sharply in March





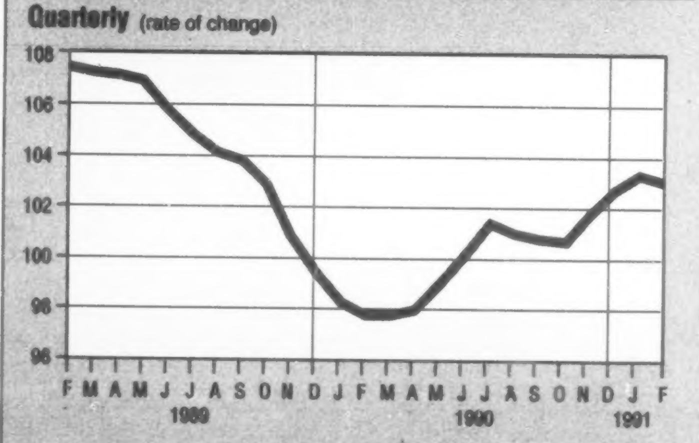
Leading Indicator rises sharply in March

An upturn in the electronics industry is just around the corner, according to the ELECTRONIC BUSINESS Leading Indicator (EBLI), which jumped 2.1 percentage points to 101.9 in March.

The Commerce Department recently revised the historical data for the components industry, causing minor changes to the historical data of the EBLI. Cahners Economics' forecast now calls for a high of 107 in March 1992, rather than 106.6 in January 1992.

To obtain your complimentary background paper, contact Cahners Economics, 275 Washington St., Newton, MA 02158-1630, USA; telephone (617) 630-2119; fax (617) 630-2100.

Components inventory growth is revised upward



Source: U.S. Commerce Dept.

	Latest month	Previous month	Year ago	1990 average
ELECTRONIC BUSINESS Leading Indicator (rate of change, Mar.)	101.9	99.8	99.5	99.9
U.S. semiconductor bookings ($ millions, 3-month average, Mar.)	$1,363	$1,272	$1,333	$1,254
Weekly hours of semiconductor production workers (monthly average, Feb.)	41.0	39.7	40.6	40.4
Electronic components lead time index (1977 = 100, Apr.)	91.5	78.0	82.9	80.7
S&P's semiconductor stock price index (1970 =10, monthly average, Mar.)	70.6	70.3	67.0	64.6
Change in electronic components inventories ($ millions, SA, Feb.)	-$212	$5	-$5	$33
Contracts and orders for plant and equipment ($ billions, SA, Feb.)	$41.0	$41.9	$41.1	$42.3

SA = seasonally adjusted; all other data are not seasonally adjusted

Sources: Semiconductor Industry Association, U.S. Bureau of Labor Statistics, *Electronics Purchasing*, Standard & Poor's, Commerce Dept.

CFOs report rebound in capital spending

After a brief respite, more electronics companies are gearing up to invest in capital equipment again. At least this is the view from the latest ELECTRONIC BUSINESS capital spending poll of 62 chief financial officers surveyed last February about their investment plans. Almost half said they intend to increase their capital spending this year.

These results signal a turnaround from the downward trend that had dominated earlier surveys. When asked about their spending plans for the first quarter of 1991, 44% said they would be increasing capital spending from year-ago levels, and 38% said spending would be up from the previous quarter. During the previous two quarterly surveys, the percentage of chief finanicial officers who planned to increase capital purchases in the upcoming quarter had steadily declined to 32% and 21%, respectively. The fact that more CFOs plan to increase short-term spending is encouraging since most responded to the survey prior to the end of the Gulf war.

As expected, the biggest constraint on capital budgets was the recession. Almost half of those surveyed said that the recession, or an expectation of weak sales growth, has held capital spending down so far. ☐

Capital spending plans improve

(percentage of responents)

Compared with a year ago, capital spending has or will...

	...increase	...decrease	...stay same
1990	41%	41%	18%
1991	49%	31%	20%

Source: ELECTRONIC BUSINESS

equipment shipments will grow 9%, when low inflation, a general economic recovery, and strong capital spending will benefit electronics.

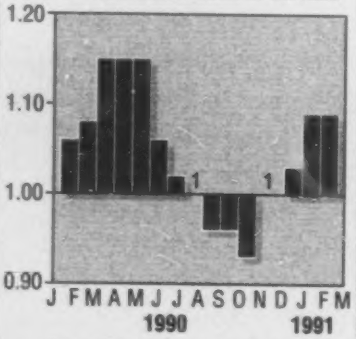
As for semiconductor sales, Jack Beedle, president of In-Stat Inc. in Scottsdale, Ariz., predicts U.S. semiconductor sales will rise around 5% this year after a 2.6% decline last year. Beedle believes the semiconductor bookings boom, which occurred in the first quarter of 1991, will have disappeared in the second quarter, just like the aborted recovery in early 1982. Why? Beedle is simply a bit more pessimistic about near-term prospects for the industry than his forecasting colleagues. Dataquest, Cahners Economics, Henderson Ventures, and TI's Catto all expect semiconductor sales growth to be a bit stronger—in the 7% to 10% range.

For 1992 Henderson and Beedle expect semiconductor sales to rise at least 20%, while Dataquest and Cahners Economics foresee growth of only 10% to 13%. The disagreement lies in uncertainty about price projections. Dataquest, for example, maintains price increases will be constrained by excess fab capacity and the lack of a major demand-pull breakthrough chip or computer system. Forecasters often disagree. What is more surprising and significant is any measure of agreement, however mixed. The consensus now is that the emerging recovery will be weak in the latter half of 1991 and somewhat stronger in 1992. As ELECTRONIC BUSINESS rounds up the figures, look for electronic equipment shipments to grow around 5% in 1990 and perhaps double that rate at 10% in 1991. ☐

The electronics industry:

Semi book-to-bill is up also...

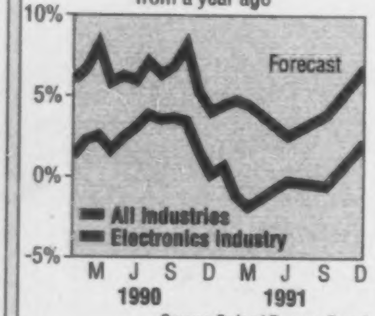
U.S. semiconductor book-to-bill ratio



Source: Semiconductor Industry Association

...which all bodes well for electronics

Industrial output, percentage change from a year ago



Source: Federal Reserve Board; Forecast: Cahners Economics

Notebook computers grow up in a hurry

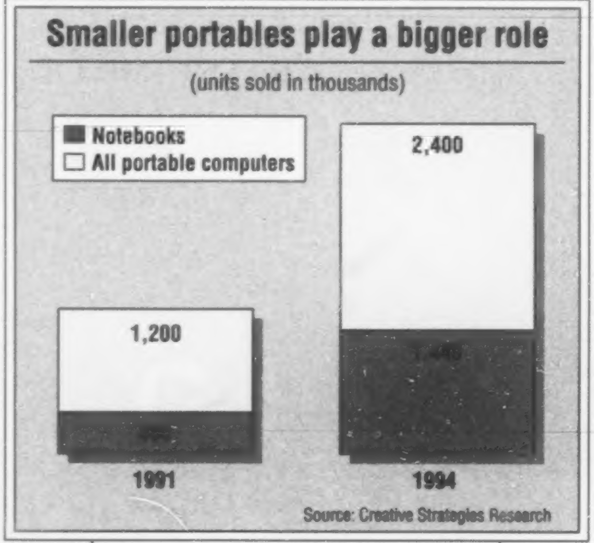
Supply problems have faded, the manufacturer lineup has grown, and prices will fall even further

By John Parker

What weighs 4 to 7 pounds, measures 8.5 inches by 11 inches by 3 inches, and breaks all the rules of high-tech pricing and production? Answer: the next $5 billion computer market.

That's the value some analysts put on the market for notebook computers by 1995. Reaching that lofty figure will mean new strategic partnerships and a down-and-dirty price war that experts claim already has turned new technology into a commodity business.

Until this year, the notebook computer business had been hampered by chronic supply problems resulting in tepid sales growth. In the U.S. retail channel, unit sales of notebook computers went from 37,000 in the first quarter of 1990 to only 39,000 in the fourth quarter, according to Storeboard Inc. in Dallas, a specialist in tracking sales of computer products. Retail sales figures actually declined in midyear, dropping from 42,000 units in the second quarter to 40,500 in the third.



Smaller portables play a bigger role

(units sold in thousands)

Source: Creative Strategies Research

"We heard a lot about how notebook portables would be a growth area in 1990," explains Storeboard's JoAnn Stahel. "Spring Comdex 1990 was a blitz on all portables, and everybody was pointing to notebook introductions and saying, 'Look what we can do down the line.' But then there was no delivery."

That has been frustrating to retailers such as The Laptop Shop in Manhattan, where sales manager Bill Gray was still waiting in early April for a shipment of notebook computers announced three months earlier by AST Research. But Gray says supply problems in general are starting to fade, and sales of the retailer's six lines of notebook computers now account for 60% to 70% of its business, versus 30% six months ago. With increasing variety and demand come falling prices. The average notebook price dropped from $3,000 in September to $2,000 in March, says Gray.

The story is similar at the San Jose headquarters of PC channel leader Businessland Inc. "NEC was teasing the market with its UltraLite. They were amazed at the response," says Randy Crocker, who is product-line director for laptop and notebook computers. "Now those units are going for $689."

PRICING IS AS erratic at the high end of the notebook market. Only seven months ago, Houston's Compaq Computer Corp. offered its 386SX LTE model at roughly $6,500. Dell Computer and AST quickly countered with their 386SX versions, selling at around $3,500. Analysts say that process has cut gross margins on notebook computers to an average of 30%, more than five percentage points below the average for other PC product lines. Overall, distributors and manufacturers see average list prices in the notebook computer market declining roughly 10% every six months, compared with 10% per year in the PC market as a whole.

Many observers predict white-hot growth for notebooks for the next few years. Hambrecht & Quist analyst Bill Lupatkin sees 1991 sales topping 1 million units, with the notebook market maintaining 50% annual growth. BIS Strategic Decisions in Norwell, Mass., predicts that growth in sales of notebook computers will dramatically outpace growth of the overall portable computer market over the next five years. BIS has notebook computers contributing $800 million (15%) to a 1990 portable computer market of $5.5 billion; by 1995, according to BIS analysts, notebook computer sales alone will have risen to $4.7 billion—roughly 30% of the total portable computer market of $15.7 billion.

Behind the demand for notebook computers, say industry experts, are several major factors: a savvier population of computer buyers, improving manufacturing technology, and a commitment by major companies in desperate need of a growth market.

"You could say notebooks are becoming a commodity market, largely because people are clearer on what they want from the technology," says analyst Tim Bajarin at Creative Strategies Research in Santa Clara, Calif. "About 90% use portables as secondary systems—as extensions of desktop computers—so there's a natural evolution."

Hambrecht & Quist's Lupatkin agrees that buyers of notebook models are probably "a little different" from buyers of desktop PCs. The products will be sold mostly to individuals rather than to corporate purchasers, he explains, which implies more price-sensitivity. Moreover, says Businessland's Crocker, those individual buyers of second computers are attracted by high-end features. A full of them 60% want modems attached, while 25% spring for lightweight printers. Even battery-powered CD-ROM players are now in demand. "Notebooks are fun to sell," he says. "They're a status symbol—sexy and sleek—so there is a lot of pull on the product."

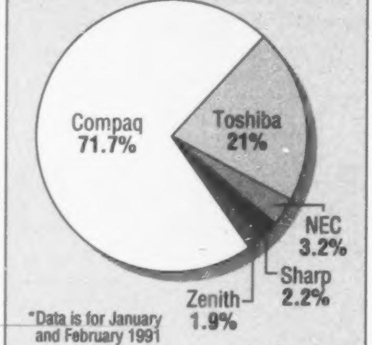
What will differentiate future notebook computers technologically? Advanced VGA displays, flash ROM, and mass storage are areas targeted by many manufacturers. "Unlike the desktop world, there's plenty of room for product differentiation," says Tom Martin at Toshiba Corp. in Irvine, Calif. "Volume buyers need color, and they need communications capabilities. That's why we make five kinds of notebooks."

Businessland's Crocker sees the promise of big corporate orders as well, pointing to the *Fortune* 100 company that recently ordered 500 notebook computers. "What's exciting to them is that you can bring a desktop-computer advantage to the field sales level—actually using it as a sales tool."

ANOTHER REASON for the notebooks' success is the advances in enabling technologies such as liquid crystal displays, miniature memory chips, and nickel-hydride batteries, all of which make it possible to offer high-performance notebooks in quantity. Bringing these technologies to market has meant partnerships between U.S. computer makers and Japanese companies, such as Toshiba and Sony Corp., that dominate the technologies and are leading in manufacturing miniaturization.

Slicing up the notebook retail market

(U.S. market share by manufacturer)*



*Data is for January and February 1991

Source: StoreBoard Inc.

But while notebook computers may be easy to sell, they're hard to make, compared with desktop and even laptop PCs. That's because the small form factor prevents the simple assembly of standard PC components from a variety of sources. "Design is one thing, manufacturing is another," says K. W. Jun, director of marketing at Samsung U.S. in San Jose.

Nevertheless, the presence of industry giants such as these in the emerging notebook market is causing component makers to ramp up production. An example is Conner Peripherals in San Jose, the only U.S. source for 60-megabyte, 2.5-inch disk drives. Conner is the source of disk drives not only for 19% stakeholder Compaq, but also for IBM's first notebook market entry (announced in late March). Samsung also buys its 2.5-inch drives from Conner, but Jun sees drive makers Quantum and Western Digital entering the market later this year.

With a well-established customer demand, several major players have recently emerged to secure their places on the notebook bandwagon. The results have already shown up at the cash register: In January and February of this year alone, says Storeboard's Stahel, computer retailers reported sales of 30,000 notebook units, compared with the 37,000 logged for the first three months of last year. Stahel adds, however, that only a third of today's notebooks sell through computer retailers such as Businessland; the vast majority are sold through direct sales or mass-merchandisers.

Not surprisingly, large companies with experience in the portable computer market have an easier time ramping up production, thanks to their long-standing relationship with component suppliers. Although early supply problems dampened sales of Compaq's popular LTE, the company fully expects to catch up with back orders, according to Richard Swingle, director of strategic marketing. Toshiba's strategy for dealing with the supply issue rests on its size and ability to cultivate a large base of component suppliers for its 14 models of portable computers, says vice president of marketing Tom Martin.

IBM's $5,995 portable was a watershed in notebook-computer history, even though Big Blue straddled the line between laptop and notebook. The caution is understandable: IBM had to withdraw its PC Convertible in 1989 and delay its laptop introduction for a year as prototypes flopped.

IBM's 386SX notebook weighs in at 7.7 pounds, putting it in the notebook weight class, but it keeps a full keyboard that gives it the form factor of a laptop. "IBM recognizes the significance of this marketplace," according to IBM spokesperson Kevin Clark. "People are just going to want smaller machines." To test the market for IBM computers with a notebook form factor, IBM Japan is releasing a smaller version with a Kanji keyboard for its Japanese customers.

Also running to catch the notebook bandwagon is Cupertino, Calif.-based Apple Computer Inc., which has partnered with a Japanese manufacturer (rumored earlier this year to be Sony). Three notebook-size Macintosh models, priced from $2,500 to $5,000, are expected to hit the market in September. "We missed the laptop market," admitted Apple chairman and CEO John Sculley in a recent speech to the Software Publishers Association. "We're not going to miss the notebook market."

NEITHER WILL anyone else, apparently. The list of manufacturers crowding the notebook market in the past 18 months reads like a condensed history of personal computing. U.S. companies (including Compaq, Texas Instruments, and Zenith Data Systems) are being followed and overshadowed by Japanese component makers and OEMs such as NEC and Toshiba, who are being followed in turn by Korean and Taiwanese OEMs. Korean computer giant Samsung, for example, started shipping its 20-Mbyte-drive notebook computer in February at a list price of $3,999. Last month, Taiwan-based Acer Inc. was preparing to introduce models with 20-Mbyte, 40-Mbyte, and 60-Mbyte drives. Company sources were cagey about the price tags, however, saying only that the notebooks would list at more than $3,000.

While buyers of notebook computers have plenty of brand names to choose from, the needs of the corporate volume buyer may close that end of the market to many OEMs. "To meet the needs of the volume buyer, it's got to be more than a toy," according to Compaq's Swingle. "Business users now understand that a 20-Mbyte drive is marginal; just running Windows and a couple of applications eats up 12 Mbytes to 15 Mbytes. Salespeople need to connect to the office network, even when they are overseas." Just as important, the computers must be sturdy. "If you buy a hundred of these for your company," Swingle continues, "you don't want them to break when you drive around with them in the trunk of your car." ☐

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MY VIEW

The new paradigm

ACCORDING TO DATAQUEST, Motorola—a $10.9 billion company—is also the largest U.S. semiconductor company and the fourth largest semiconductor manufacturer in the world.

Recently I attended a three-day Motorola Semiconductor press and financial community briefing in Austin. The purpose of the get-together was to discuss Motorola's product and market strategies, give the press and financial types an opportunity to have one-on-one discussions with Moto execs, and dedicate the new $500-plus million MOS-11 manufacturing facility there. Five hundred million smackers. Wow!

The '90s is going to be an exciting decade—2000, here we come! And the Moto folks described just how exciting it is going to be. Not just the expected technology whiz-bangs, or management's focus on the value chain to reduce time to market and improve customer satisfaction. No, there's more to the paradigm. And the more part has to do with managing the softer issues. Listening to the customer. And managing relationships.

Rank	Company	1990 semiconductor sales ($ billions)
1.	NEC	4.5
2.	Toshiba	4.4
3.	Hitachi	3.5
4.	Motorola	3.4
5.	Intel	2.9

Source: Dataquest

On the second day of the meeting Chris Galvin, grandson of the founder of Motorola, talked about the history of the company. Talked about how his grandfather, Paul Galvin, [illegible] failed twice in business. How he [illegible] himself up and in 1928 started [illegible]. Chris talked about the Motorola strategy, the commitment to Six Sigma, and Motorola's entry into the fluorescent lighting ballast business with an electronic ballast that would replace the old magnetic version. What? What's Moto doing in the fluorescent lighting ballast business?

Now, I don't know diddley about fluorescent lights. But I do know Chris Galvin's remarks about how the electronic ballast would change the economics of that marketplace really set me on my ear. Dramatic energy-cost savings, improved performance in light quality, low harmonic distortion, and no flicker. All market-entry advantages. But what hit me most was the use of six sigma quality as a competitive weapon. The Motorola product strategy is to delay introduction until the quality levels are 5.7 sigma or higher. Think about it. Motorola's quality levels would likely be 4,000 times better than the competition, based on my assumption that magnetic ballasts quality levels are in the three-sigma range. It may be a lousy assumption on my part, and my math may be rusty, but you get my point.

I have been in the electronics business 35 years, and this is the first time I have ever heard an American executive talk about using quality as a competitive advantage and then tying numbers to the quality promise. No slogans. No empty, arm-waving quality claims. Numbers. Think about it. The new paradigm suggests one search for major market segments where your technology gets you in the door and your quality changes the rules of the game.

New paradigm indeed.

—Frank Burge, Publisher

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SPECIAL REPORT

PRODUCT
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30°
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ELECTRONIC BUSINESS

PRODUCT DEVELOPMENT AS A PROCESS

THE COMPETITIVE BATTLEFIELD OF THE '90s

Rick Whiting

Electronic Business

FOR THE MANAGEMENT TEAM IN ELECTRONICS, COMPUTER, AND SYSTEMS COMPANIES—WORLDWIDE
VOLUME 17, NO. 12
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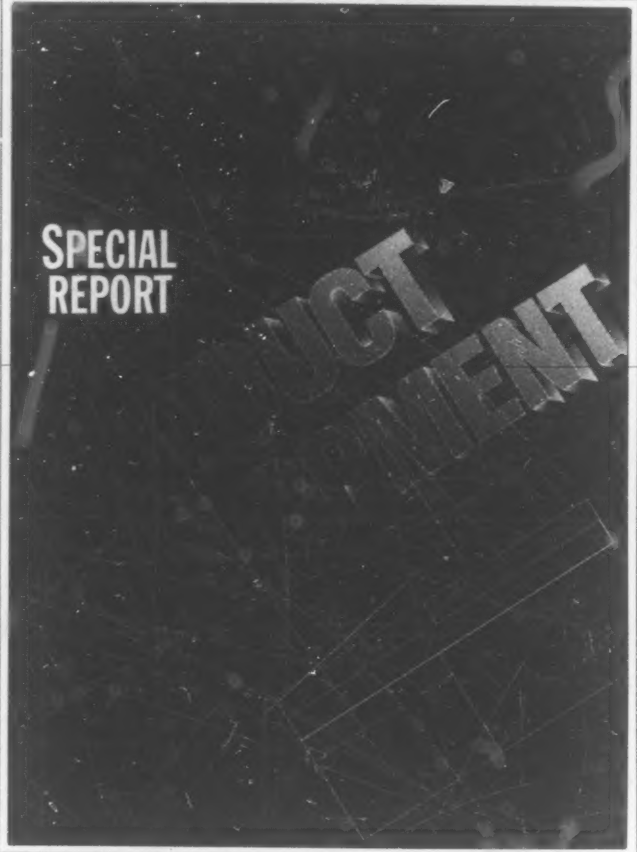

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Cover illustration by Chuck Mackey

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INSIDE BUSINESS

The next big challenge: cutting time to market

Senior editor Whiting: the process, not the program

HISTORY WILL witness that focusing on short-term profitability cost U.S. companies in manufacturing quality, the business battlefield of the 1980s. But history doesn't have to repeat itself.

The arena of the 1990s will be product development, the subject of this issue's special report. "If the '80s were rife with manufacturing terms such as 'just in time,' the resounding slogan of the '90s will be 'time to market,' " says senior editor Rick Whiting. The rewards of cutting time to market are substantial: increased product revenue, reduced costs, and quickened response to the competition.

Experts agree that the quality lessons of the '80s can be used to capture those objectives. Documenting and benchmarking performance can help create a stable and predictable product development process; and, as with total quality management, it's the *process*, not the specific program, that makes the difference, and involvement in the development process should extend to suppliers. A prime example is the collaboration between computer maker Compaq and chip maker Intel, which let Compaq bring its Deskpro 386 computer to market in a scant six weeks.

Cutting time to market will mean breaking some long-standing habits, among them the penchant for hanging on to failing projects rather than admitting to a mistake and canceling it early on. It means shifting from top-down supervision to a team development model.

For inspiration, U.S. executives can look across the Atlantic to the $122-million-a-year effort underway at Thomson Consumer Electronics. As London bureau chief Barbara Berkman reports, Thomson faces a major challenge in bringing its HDTV systems to market quickly—from competitor Sony Corp. and from Thomson's own weak record in time to market.

Since U.S. electronics companies were caught napping by quality-conscious Japanese manufacturers in the great campaign of the '80s, it is wise to look at the Japanese strategy for the product development struggle. That strategy gets a thorough examination from consulting editor Lew Young, a longtime observer of the Asian electronics industry.

Winning the time-to-market competition will require major changes in organization and corporate culture, but with so much at stake, it's a good bet that many of our readers will meet the challenge.

—John Parker, contributing editor

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BPA ABP

SEMICONDUCTORS

Chip makers advised to study Eastern Europe for new markets

THE WORLD semiconductor market will grow substantially during the next nine years, concluded a forum of industry-watchers at the annual In-Stat Inc. conference in May. But for U.S. companies, the most promising market opportunities will be in Eastern Europe, not in the States.

Worldwide semiconductor sales are expected to grow from $54 billion this year to almost $200 billion by the year 2000, industry executives predict, with the most spectacular growth coming from Korea, and Western and Eastern Europe. The U.S. market can expect only modest gains until the end of the decade.

Experts say impressive growth rates will come from developing nations. Eastern Europe, which now substantially lags the rest of the world in semiconductor production, may be a potent force by the end of the decade, says Malcolm Penn, president of In-Stat's European operation.

Until then, the Eastern European market represents the single largest market opportunity for U.S., Asian, and Western European chip companies, Penn says, because relaxed export restrictions will make it easier to sell there. Eastern European countries now import very few products from the West, but Penn says that is changing.

In 1990 the entire Eastern European market was worth about $2.11 billion, or roughly the same as the United Kingdom or what was formerly West Germany, Penn says. The Eastern Europeans have a production capacity worth about $2.06 billion, or about half the size of NEC's or Toshiba's, he added.

Asia-Pacific countries will do well in the next decade as well, industry experts say. Sales of Korean chips will grow from $8.4 billion to slightly more than $40 billion by the end of the decade, says C. S. Park of Hyundai Electronics in Korea. To support that growth, the Korean industry plans huge investments in capital equipment over the next four years. The industry will invest $1 billion in equipment this year, and $1.8 billion by 1993.

Eastern Europe semi production

($ millions)

USSR	1300
East Germany	250
Poland	130
Yugoslavia	103
Czechoslovakia	100
Other*	231

1990 total: $2.11 billion

*Other includes Bulgaria, Hungary, and Rumania

Source: In-Stat

But Park warned that his nation's economy is too dependent on DRAMs for its long-term health, and that Korean companies must make the switch to other products.

The now-sluggish U.S. chip market will grow between 12% and 13% per year during the decade, conference attendees predict. Driving that increase will be greater demand for microprocessors incorporating more and more functionality. The technology of application-specific ICs will continue to proliferate, making sales of specialty chips mushroom in the coming years.

But industry watchers warn that if U.S. executives are looking to the DRAM market for help, they should think again. That market will continue to be volatile, and although the chips will be increasingly important as memory-intensive products such as HDTV come on line, prices will be uneven through the decade.

Chip sales in Western Europe will

Industry bids farewell to Sporck

Cindy Charles

On May 23, Charlie Sporck, president and CEO of National Semiconductor, retired after 31 years in the semiconductor industry. The evening was marked by hugs and reminiscing, rowdy stories and sincere admiration. Recalling early days at Fairchild Semiconductor, Gordon Moore, chairman of Intel Corp., noted, "to say there was a healthy tension between marketing and manufacturing during our meetings is an understatement. Charlie once broke his hand pounding the table."

grow only 7.3% this year, but demand should skyrocket as the market unifies by the end of 1992, says In-Stat's Penn. Semiconductors for the communications and computer markets will be strong sellers over the next nine years.

—Valerie Rice

SEMICONDUCTOR STATISTICS

Why the semi rankings don't always add up

WHEN INTEGRATED Circuit Engineering Corp. and ELECTRONIC BUSINESS ranked the top 50 IC manufacturers (Apr. 8), many readers wondered why the rankings by different consultants didn't add up to the same number.

One reason is that analysts do not simply copy numbers from annual reports. The process of tallying semiconductor sales is complex; the task is further complicated by the method each consultant uses to treat internal transfers and subcontracting. All try to avoid double-counting figures, and as subcontracting becomes more prevalent, the room for errors increases. "If Intel gets EPROMs from Samsung, we try to eliminate it from the total," says ICE's Bill McClean. "But sometimes it creeps in."

What type of components does each consulting house include? According to sources, San Jose's Dataquest includes hybrids, which makes their semiconductor-revenue figures (especially in the case of Japanese companies) higher than those of other consultants. ICE tries to count only the value of the IC that goes into the packet, so the module's packaging charges are not included. Some consultants include nonrecurring engineering charges. The Semiconductor Industry Association and In-Stat (which pegs their data to SIA figures) exclude such engineering charges.

Add to the confusion different conversion factors as yen are translated into dollars and fiscal years into calendar years, along with disclosure problems from European companies and competing companies, and it's little wonder that the top semiconductor lists from consultants are all different.

No matter which company is the leader, the worldwide market should come to some $54 billion this year—at least according to a recent In-Stat forum. But as one analyst told ELECTRONIC BUSINESS, "All the numbers evolve. There are no absolutes."

—Elizabeth B. Baatz

Top semi makers according to three consultants

1990 U.S. chip sales ($ millions)

Dataquest		ICE		In-Stat	
NEC	4,952	NEC	4,795	Toshiba	4,326
Toshiba	4,905	Toshiba	4,620	NEC	4,005
Hitachi	3,927	Hitachi	3,675	Hitachi	3,460
Motorola	3,692	Motorola	3,590	Motorola	3,433
Intel	3,135	Intel	2,915	Intel	2,941

Compiled by ELECTRONIC BUSINESS

INTERNATIONAL

EC moves to save European HDTV

IN A COMPROMISE to appease feuding European television manufacturers and broadcasters, the European Commission proposes to save the so-called MAC broadcasting standard as a precursor to a European standard for high-definition TV.

The Commission is expected to rule that, by the end of 1991, all high-end TVs be MAC-compatible; lower-end models could remain based on PAL, the current broadcast standard, until European unit demand for MAC systems reaches a yet-to-be-determined critical mass. At that time, all European broadcasters must switch to MAC.

The compromise was necessary after British and German broadcasters from Europe's fledgling satellite broadcast industry argued to the Commission that the advanced PAL standard is a fine alternative to MAC. They want to continue broadcasting in PAL because it dwarfs today's MAC market. The broadcasters added that at $6,000 per set, few consumers can afford to buy the MAC-based units now being developed by N.V. Philips, Thomson Consumer Electronics, Grundig, and Nokia.

HDTV was supposed to be the savior of Europe's consumer-electronics manufacturers, and the EC and individual governments have spent millions of dollars so far funding Eureka-95, a project charged with producing a working European HDTV system by 1995. Eureka members chose MAC over PAL as the route to European HDTV, arguing it was more expensive but technically superior. They plunged ahead on MAC-based decoders, receivers, and TV sets.

But the MAC decoder market in Britain went virtually overnight from 750,000 potential units to zero when two competing satellite broadcast companies merged then decreed it would broadcast in PAL and abandon MAC by next year. The effect on Thomson's and Philips's product development was devastating. Thomson, whose first HDTV-compatible television, based on MAC, was due to hit the British market in 1991, closed its 45-engineer MAC decoder research site. "It makes it harder to promote an HDTV format in the U.K.," agrees David Brooks, at Thomson Consumer Electronics' R&D labs.

—Barbara N. Berkman

Continued on page 12

deemed DOD-compliant, as will all of its products. That means no more teams of auditors each time a new product is released, and no more superfluous product testing at various temperatures or humidities.

But getting the DOD's OK is not painless; the process normally takes at least two years. That's how long it took for Intel Corp.'s defense systems division, says general manager Ron Williams. Once the applicant has provided statistical proof of the quality processes and results, the vendor undergoes a validation audit; if successful, the vendor is put on a validated manufacturers list. For a year after that, statistical process data must be sent to the Defense Electronics Supply Center on a weekly basis. The final step is a one-week audit by DESC, after which the vendor joins the ranks of the qualified.

The Defense Logistics Agency recently allocated about $2 million to DESC to speed up the program, which started in 1984. But by 1988, the project had floundered due to lack of funding.

—Peter Burrows

COMPETITIVENESS

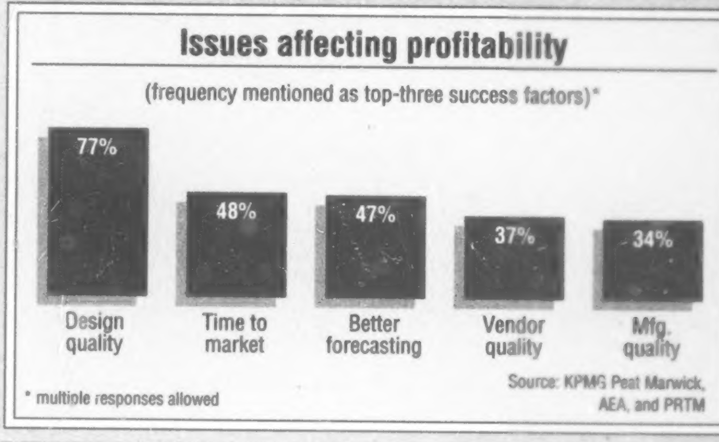
Designing for quality

QUALITY AND PRODUCT reliability are the most important factors for success in high-tech markets, according to the American Electronics Association's 1991 Productivity Survey of CEOs, presidents, and general managers of companies in high-tech industries.

Of the 311 companies included in the survey, quality of engineering design was mentioned by 77% of the companies as having a major impact on profitability. The survey indicates that more companies are getting the manufacturing function involved earlier in design activities in order to address the quality issue. Competition from foreign companies, especially those from the Pacific Rim, is in part responsible for the emphasis on product quality and time to market.

The survey was conducted for the AEA by consulting firm Pittiglio Rabin Todd & McGrath and the high-tech practice of KPMG Peat Marwick.

—Barbara Jorgensen


Issues affecting profitability

(frequency mentioned as top-three success factors)*

* multiple responses allowed

Source: KPMG Peat Marwick, AEA, and PRTM

TRADE

Small companies find ally in unfair-trade cases

IN EARLY 1989, Geoffrey Wyatt, vice president of a small molecular-measuring instrument company, discovered that a multibillion-dollar Japanese competitor was selling instruments similar to the ones produced by his company at less than half the price, well below what Wyatt Technology Corp. charged for its instruments in the United States. Wyatt knew that his $8 million company was in serious danger and had to act before the vendor underpriced him out of the market.

But legal assistance was prohibitively expensive for Wyatt Technology, essentially a father-and-son business based in Santa Barbara, Calif. Wyatt's search finally led to a small, relatively unknown agency within the International Trade Commission known as the Trade Remedy Assistance Office.

Within three months, the ITC barred the Japanese vendor from shipping its instruments pending an investigation of Wyatt's dumping allegations. Six months later, the ITC slapped a 130% tariff on Otsuka Electronics, the offending company.

TRAO provides a helping hand to small U.S. companies—those with fewer than 500 employees against unfair foreign trade practices. "We were facing this huge Japanese corporation that had some of the best legal counsel money can buy, and we beat them," muses Wyatt. "And it took less than nine months. It's a very quick process."

A U.S. company has only to allege that its technology, as defined by the Trade Act of 1988, is being threatened by foreign trade practices. If the determination is made that a threat to an emerging U.S. technology exists, the ITC determines a recommendation for action to the U.S. Department of Commerce.

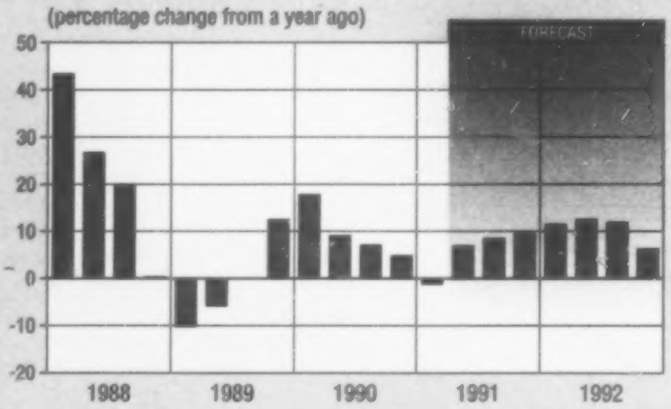
"What's really shocking," says president Philip Wyatt, "is that only 10 companies have gone through [TRAO] in the last year. These guys cessentially tell you for free how to protect yourself from dumping."

For information on the TRAO, phone the ITC at (800) 343-9822.

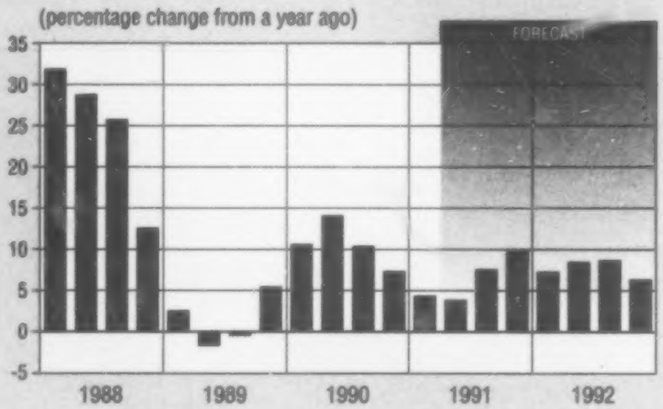
—Dave Webb

Answers: *1. c 2. a 3. Intergalactic Digital Research 4. shoes for walking on water 5. b*

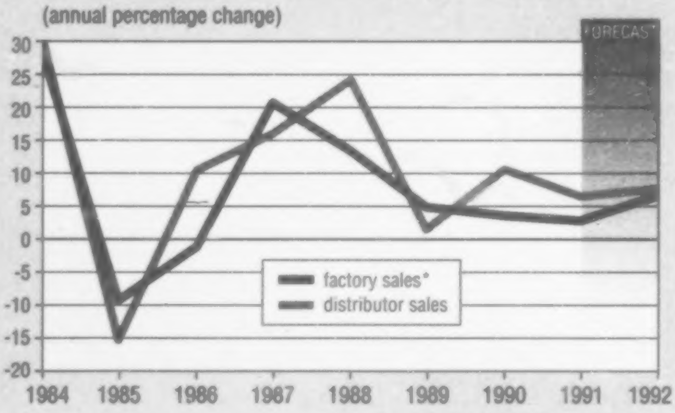
Electronic distributor orders rise in early '91...



...while shipments remain steady...



...and distribution outperforms the market



*factory shipments of components

Source: National Electronic Distributors Assn. and Commerce Dept.
forecast: Cahners Economics

Distributor orders fall, hope for rebound remains

AFTER AN explosion in orders in the first three months of 1990, the nation's largest electronics distributors report that orders dwindled 1.3% during the first quarter of 1991. This is the first time the industry has seen shrinking demand since the second quarter of 1989. The slowdown, however, does not rule out a brisk rebound in the near future.

Distributor orders may have fallen, and the book-to-bill ratio slipped below 1.0 this past March, but there is good news. A more reliable statistic for tracking the health of distribution is electronics distributor shipments. Even though shipments came in somewhat lower than Cahners Economics had predicted, there was still solid growth—4.4% in the first quarter of 1991 compared with a year ago.

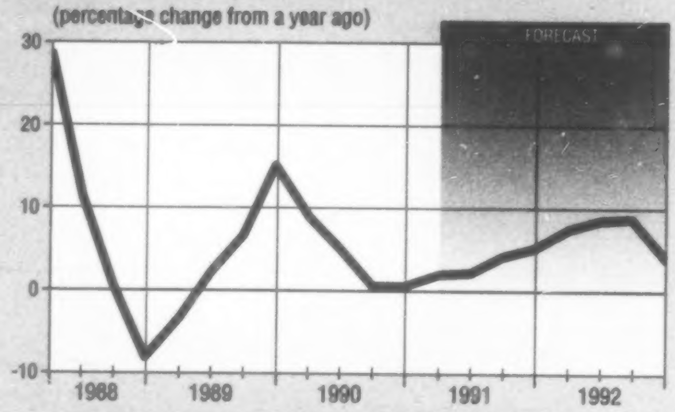
Because first-quarter data came in lower than expected for both shipments and orders, we have lowered our forecasts accordingly. We still expect a rebound in the second half of this year; shipments will advance 6.5% by the end of 1991 and 7.7% next year, and orders are expected to climb 5.9% this year and 10.6% in 1992.

Even though we lowered our distributor forecasts from three months ago, Cahners Economics' forecasts may still seem optimistic given the prevailing low business-confidence levels. However, distributors' shipments and orders growth usually fall in line with that of the electronic components sector. With interest rates expected to fall and computer output forecast to strengthen later this year, distributors' growth will also see an upturn soon.

—Julie Handelman

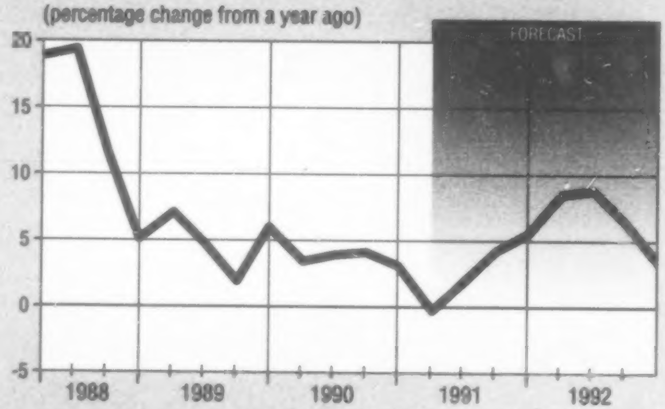
For more information on Cahners Economics' forecasting services, contact Dan Buchan at (617) 630-2105, by fax at (617) 630-2100, or write Cahners Economics, 275 Washington St., Newton, MA 02158, USA

As orders for components begin to rise...



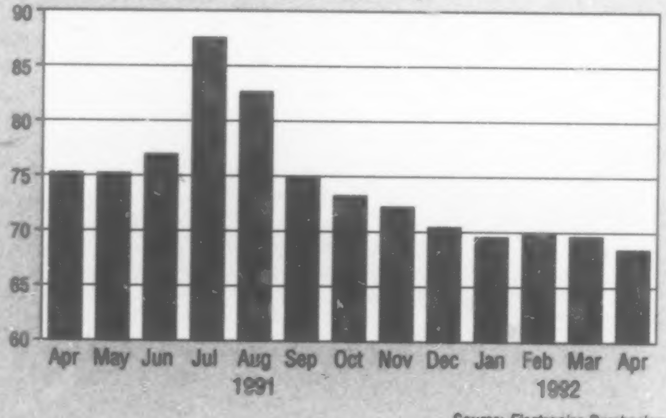
Source: Commerce Dept.; forecast: Cahners Economics

...factory shipments growth follows suit...



Source: Commerce Dept.; forecast: Cahners Economics

...and prices remain low



Source: *Electronics Purchasing*

Components industry poised for mild growth in '91

NOW, ALMOST halfway through 1991, it appears the components industry will see milder growth than originally expected. After rising 3.7% in 1990, new orders for electronic components inched up a meager 2% to $15.6 billion in the first three months of 1991 from year-ago levels, slightly lower than the 3.5% gain we had originally forecast. The orders path has been far from even: Orders swelled 19% in February and sagged 4.6% in March from year-ago levels.

Component shipments were weak too, slipping 0.3% in the first quarter of 1991 to $15.2 billion. The last time components shipments fell was in the second quarter of 1986. Despite this small drop, Cahners Economics still expects the industry to see a slight rebound in the second quarter of this year. As output from the computer industry begins to pick up later this year, demand for electronic components will improve as well. Both shipments and orders will see single-digit growth in every quarter this year and in 1992. By the end of this year, electronic component shipments will rise 2.8% and 6.7% in 1992. New orders will grow both this year and next, increasing by 3.4% and 7.2% respectively.

As demand for chips stays low, prices for most electronic components also remains weak. According to ELECTRONIC BUSINESS's sister publication *Electronics Purchasing*, the semiconductor price index stood at 68.5 (July 1989 = 100) in April, down slightly from the previous month. The trend for the past five months indicates that semiconductor prices have stabilized. It wasn't until this past April that the price index saw a more significant drop in prices. As end-market demand increases and the electronics industry begins to see stronger growth, look for semiconductor prices to rise slightly early next year.

—*Julie Handelman*

PCs get smarter
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Software battles ahead
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Taking on Intel
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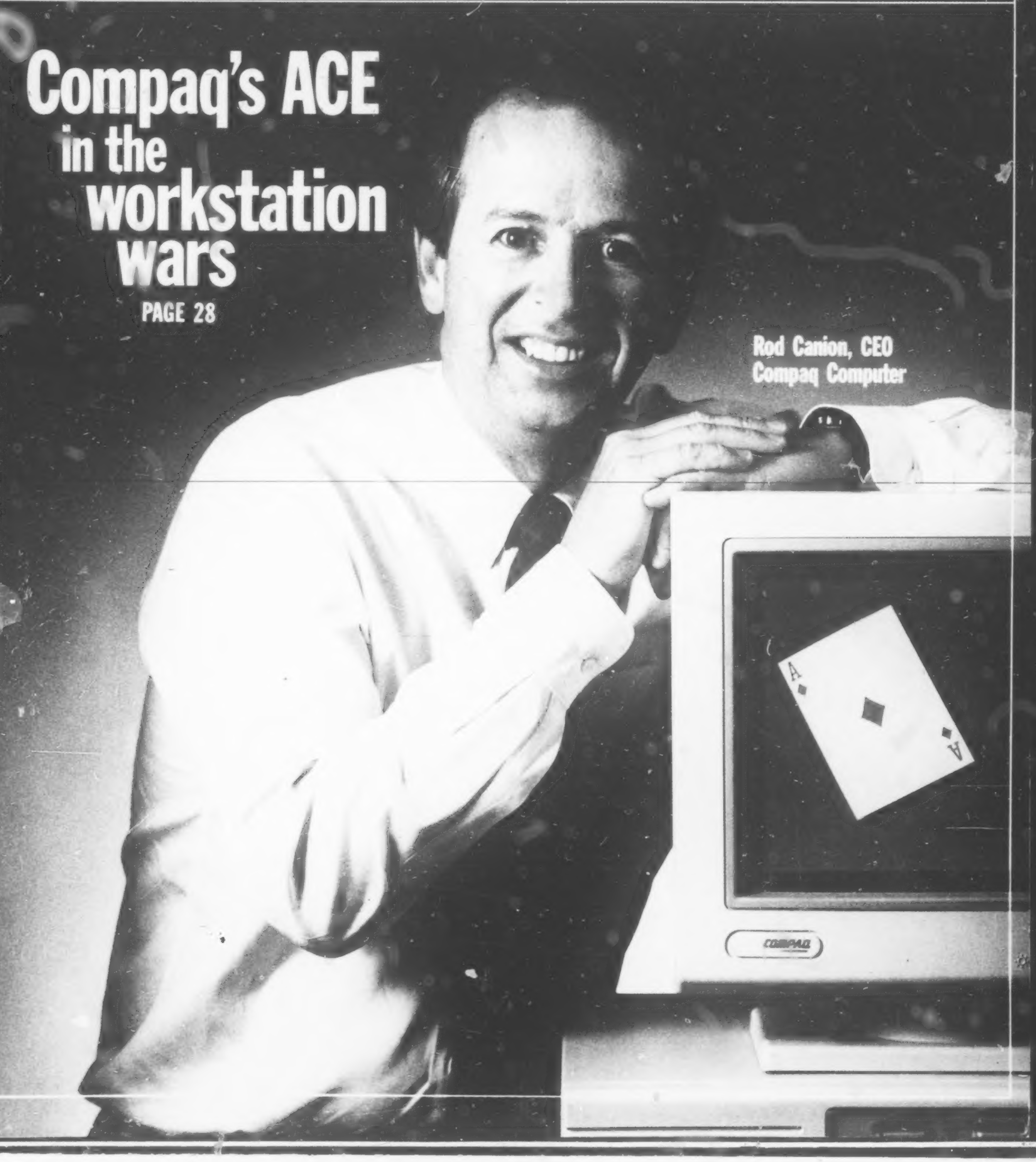
FOR THE MANAGEMENT TEAM IN ELECTRONICS, COMPUTER, AND SYSTEMS COMPANIES—WORLDWIDE
JULY 8, 1991

Compaq's ACE in the workstation wars

PAGE 28



Rod Canion, CEO
Compaq Computer

Electronic Business

FOR THE MANAGEMENT TEAM IN ELECTRONICS, COMPUTER, AND SYSTEMS COMPANIES WORLDWIDE

VOLUME 17, NUMBER 13

JULY 8, 1991

Cover: Don Glentzer

PAGE 28 Compaq CEO Rod Canion predicts that by moving into workstation architectures, the company will eventually double in size

COVER STORY

28 New alliances promise to reshape the desktop

So far, the Advanced Computing Environment, or ACE, has been little more than a mere war of words. While ACE promises to revamp the PC and workstation markets by linking Compaq, Microsoft, Digital Equipment, Mips Computer Systems, The Santa Cruz Operation, and Silicon Graphics, the battle plan is still far from clear. This special report assesses ACE's big guns, their stakes in the alliance, and how they plan to change the computer industry

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Even before ACE, the line between PCs and workstations was becoming less and less distinct. Now the alliance has put Compaq on a collision course with workstation powerhouse Sun. Compaq's success will depend largely on whether ACE turns out to be more than just another bit of empty rhetoric

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For now, Intel can afford to dismiss ACE as a "tempest in a teapot." But others take a less breezy view. If the alliance succeeds, it will be a "slap in the face" for the microprocessor giant and a new lease on life for little Mips Computer Systems. It's now up to Intel to make the next move

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Behind the facade of smiling faces and cheerful executives, ACE consists of a variety of plots, hidden agendas, and new alliances. In any case, it's hard to argue with one analyst's view that ACE makes Microsoft "the most powerful company in the computer industry"

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Until recently, most European governments had a unique solution for their faltering electronics companies: another slug of cash. But with 1992 in view, the policy makers in Brussels are ruling against such anticompetitive policies. Instead, European electronics companies must find new ways—including alliances with outsiders—to stand on their own

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INSIDE BUSINESS

Tracking the flight of the ACE alliance

Senior editor Teri Sprackland

MAKING SENSE of the computer industry's galaxy of strategic alliances is like studying the competing cosmologies of medieval philosophers: It's easy to get lost in the details. But when such supernovae as Compaq Computer, Microsoft, and DEC appear to be moving into conjunction, the economic consequences are urgent enough to warrant a serious examination.

The Advanced Computing Environment alliance is an important phenomenon, whether you view it as "The Universe According to Compaq" or "When Workstation and PC Worlds Collide." In this issue, editors Teri Sprackland, Dave Webb, Elizabeth Baatz, and Rick Whiting, joined by contributing editor Dwight Davis, explore ACE in a four-dimensional special report that covers its effect on the chip, software, and systems markets, as well as analyzing the strategy of Compaq and its allies.

For chip makers, there's a large element of risk in the ACE initiative. Intel Corp. executives like to play down the challenge posed by an adoption of Mips Computer Systems' chip architecture. But industry analysts aren't taking the decision lightly; they see the choice of Mips's chips as part of a migration by Compaq and others to a higher-end world where the PC/workstation boundaries blur and the challenge to Intel's hegemony may be very real indeed.

To achieve their goal of a new desktop computing standard, the 21 companies endorsing ACE must somehow cut through the competition between operating system software. As our editors discovered, that won't be easy. Two OS alternatives are on the table—one from Microsoft and one from The Santa Cruz Operation—and the long-standing battle between adherents of Microsoft's OS/2 and Unix continues unabated by the ACE alliance.

Whatever the challenges and pitfalls, support for the ACE initiative is a necessary path out of the saturated commodity-style PC market. The world of sophisticated workstation-type technology is not a friendly place to play catch-up, especially in the face of competition from companies such as Sun Microsystems. Still, it may be a friendlier place than a DOS-based PC market where price tags, profit margins, and stock prices all feel the pull of gravity.

With ACE, "everybody wins," enthuses one Wall Street analyst. That's a cosmic statement that will bear watching in the months ahead.

—John Parker, contributing editor

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BPA ABP

COMPETITIVENESS

Bentsen spurs backlash against Sematech

IF SEMATECH was spoiling for a fight, it got one. At a recent joint press conference with Sen. Lloyd Bentsen (D-Tex.), the U.S. chip consortium spotlighted an issue that has been quietly debated for years—that Japanese semiconductor equipment makers deliberately withhold key technology from their U.S. customers to make them less competitive.

Bentsen, who is sponsoring a Government Accounting Office report on the topic, couldn't provide any evidence of the allegations and wouldn't name names. But Sematech officials fingered some of the largest equipment companies in the world, including Nikon and Canon.

Sematech's accusations weren't well received. Not only were they flatly denied by Japanese companies, but even some U.S. industry executives said the issue was an old one and not that unusual. Others wondered if the allegations were spurred by self-interest, since the consortium faces a tough battle with the White House for renewal next year.

Craig Barrett, executive vice president of Intel, said that he had heard stories of Nikon not selling its latest equipment but that he wasn't sure if the Japanese company's actions were any different from those a U.S. company would take. If products are scarce or early in their life cycles, he admitted, Intel might favor its best customers. "Maybe that's what they are doing," he said.

There is no doubt that the U.S. equipment industry is suffering a steep decline in worldwide market share, mostly at the hands of the Japanese. A recent report from the U.S. Commerce Department showed that the U.S. share of the equipment business dropped from 75% in 1980 to 49% in 1988, while Japan's share increased from 18% to 39% during the same period. But Barrett and others claim that the problems of the U.S. equipment industry can't be solved by pointing fingers at Japan.

Bentsen: Japan is withholding leading-edge IC technology from U.S. customers

This is not the first time Sematech has been outspoken on an industry issue. But while the charges that Japan withheld technology might have been true in the past, says one industry source, "it isn't helping the industry now to bring them up again. Sematech was trying to help itself."

—Valerie Rice

SEMICONDUCTOR EQUIPMENT

The deliberately optimistic semi equipment makers

EVEN WHILE embroiled in the Bentsen-spurred semiconductor equipment controversy, U.S. and Japanese equipment manufacturers predict an optimistic future for their respective industries.

According to the first-ever release of public data, U.S.-based trade association Semiconductor Equipment and Materials International and the Semiconductor Equipment Association of Japan jointly announced that total worldwide equipment sales rose 17.8% to $2.47 billion in the first quarter of 1991, more than reversing the prior quarter's 6.8% decline. Mask/reticle equipment and other facility-related equipment sales lead the pack with first-quarter gains of more than 40%.

Slower growth equipment categories in early 1991 included wafer process equipment, up 18.9% from year-end 1989; wafer manufacturing equipment, up 7.9%; and assembly equipment shipments, up a meager 0.9%. These statistics are now being released quarterly as part of an agreement to collect and combine data of both the U.S. and Japan equipment trade associations.

Sales in the equipment industry, which generally lag semiconductor device sales, will experience only slow growth in 1991, despite the first-quarter boost. But unlike past recessions, when orders were built up and dropped unexpectedly, the current slowdown has been characterized by more predictable order patterns.

A measured, deliberate optimism may continue to be the equipment industry's attitude for the rest of 1991. For next year, most equipment company executives appear to be relaxing their guarded outlook and are

First-quarter rebound across the board

Semiconductor equipment worldwide shipments
($ millions)

	Shipments	Change from previous quarter
All equipment	$2,471	17.8%
Wafer process equipment	1,478	18.9
Test equipment	543	13.3
Assembly equipment	201	0.9
Other facility related	153	47.4
Mask/reticle equipment	68	44.9
Wafer manufacturing equipment	28	7.9

Source: SEMI and SEAJ

gearing up for happy days again. Whether or not the tremendous capital costs of large-die plants will put a crimp in these hopeful plans remains to be seen.

—Elizabeth B. Baatz

DESIGN AUTOMATION

Is Sun-Orcad deal a bad omen for PC-based EDA?

SUN MICROSYSTEMS just added a key application in its furious race to market its Sparc computing architecture as a new standard for low-end technical computing. In May, Sun announced that Hillsboro, Ore.-based Orcad will make its electronic design automation products available on the Unix-based Sparc platform. The companies say the relationship could earn Sun $350 million and Orcad $150 million over the next five years.

Sun figures the deal translates to 45,000 units sold by 1995. "This is our single biggest design win of the year," says James C. Blaschke, Sun's director for technical markets. "Maybe our biggest ever."

The move upmarket by Orcad, which until now sold only low-cost DOS-based PC software, has somber implications for the PC-based technical software industry. Orcad, claiming the largest EDA installed base in the world with 60,000 seats, has always sworn it would not make the move to the Unix-based world of workstations, which it and others have long considered too expensive and too sophisticated for the average engineer. "We're eating some serious crow," says Joe Tanous, Orcad VP for sales and marketing.

Orcad is not alone. Rapidly falling workstation prices—and the resulting interest from customers attracted to that platform's superior speed and networking—is proving irresistible to a wide range of software vendors who grew up on the PC. While about half of all EDA is still done on PCs, the Technology Research Group in Boston expects that to fall to 40% by 1994. Orcad figures that half of its sales will be to Unix users by 1995.

But EDA on DOS isn't dead yet. Research firm Daratech points out that the huge popularity of Microsoft's Windows 3.0—a user interface that gives the PC platform some Unix-like characteristics—promises years of continued growth in DOS machines. Microsoft sold about 3 million copies of Windows 3.0 in the product's first six months on the market, says Daratech—a figure that dwarfs the total number of Unix workstations *ever* sold.

—Peter Burrows

STRATEGIES

Lex and Arrow merge

THE CONSOLIDATION of U.S. electronics distribution advanced last month when Arrow and Lex (the second- and third-largest players, respectively) announced a merger of their electronics operations.

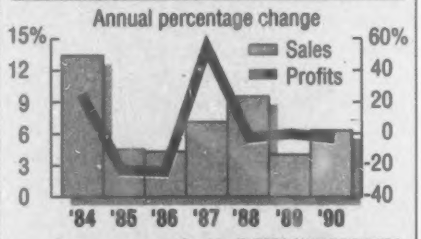
Arrow now displaces Avnet as the U.S. leader in electronics distribution, with 1991 sales estimated at $1.7 billion, and further extends its reach into Europe. Lex's parent company, Britain-based Lex Service, exits electronics entirely to focus on automobile distribution (which accounts for 70% of its business) while retaining a one-third stake in the combined operation. Analysts say the merger is good for the industry. "There [have been] too many distributors selling too many product lines," notes veteran observer Clarke Walser of The Chicago Corp.

Arrow CEO Stephen Kaufman expects the merger will accomplish considerable economies of scale for the two companies and give the new company tremendous clout. But the merger also brings under one umbrella products from all major U.S. semiconductor producers, a group notorious for not sharing shelf space. Kaufman has said that he doesn't expect any line-card conflicts, but Walser isn't so sure. "There are obvious conflicts with both semiconductors and passives," he says. "It seems to me that either Motorola or National will have to reverse their field on who they share shelf space with." If not, it will mean a loss of some business for Arrow.

So far, suppliers are taking a wait-and-see approach. AMD has long been a supplier for both companies, and distribution director Al Frugaletti notes Arrow's smooth merger with Kierulff. Still, Frugaletti predicts there will be line-card adjustments. "You've got to know where to draw the line or the customer will do it," he warns.

The merger did not include Lex's operations in Continental Europe, although Kaufman says he may bid

Whatever happened to profit growth for the ELECTRONIC BUSINESS 200?



Source: ELECTRONIC BUSINESS

The 200 largest U.S.-owned electronics companies sold $362.3 billion worth of products and services last year, up 6.3% from 1989. But while sales growth improved last year, net income growth deteriorated for the third year in a row. In fact, income for the top 200 companies has fallen in five of the past seven years. Stay tuned: The next issue of ELECTRONIC BUSINESS will feature our exclusive top 200 ranking of U.S. electronics companies.

—Elizabeth B. Baatz

on them in the future. However, notes Walser, "Avnet has made no secret about the fact that they want to move into Europe."

—Barbara Jorgensen

SEMICONDUCTORS

Mega-fabs pose threat to small players

SMALL AND MIDSIZE chip manufacturers take note: In just nine years you may be priced right out of the market.

According to a report from the National Advisory Committee on Semiconductors' Micro Tech 2000 Conference, the fab of the future will cost $2 billion and could number as few as five in the United States. If so, small and midsize chip companies with their own fabs might be squeezed out, and only the largest companies will be able to pay for the privilege of manufacturing. In fact, these fabs will be so expensive that some question whether any U.S. company will be able to pay the price.

The chip of the future

NACS recently hosted the Micro Tech 2000 Conference to draw a road map that would put the U.S. chip industry on a par with Japan by the year 2000. The aim is to put the power of a supercomputer on a single chip. Among the findings:

- Fabs will cost $2 billion and produce 10,000 wafers per week;
- The industry will need 0.1 micron chip equipment;
- A state-of-the-art chip will have three layers of circuits, 100 million transistors, and operate at 300 to 400 megahertz. (Today's average is 20 to 25 MHz and 1 million transistors).

—Valerie Rice

But while NACS stressed that the Micro Tech proposal was just one suggestion to aid the U.S. competitive stance with Japan, some sources believe that the "mega-fab" idea was the wrong direction to take. Arguing that the healthiest part of the chip industry is in small companies, many said the industry should concentrate on smaller, flexible fabs that could be altered quickly and cheaply. Others said the push to develop new technologies ignores what is really wrong—scarce working capital.

NACS chairman Ian Ross said the proposal would not force small companies out but instead would make them work more closely—perhaps by joining together to own a fab.

—Valerie Rice

COMPUTERS

Of price wars and PCs

IF THE REASONS for the PC price wars of late weren't evident before Spring Comdex, visitors to the Atlanta show left with no doubts: The number of PC clone makers is growing, especially in the notebook and laptop segments.

With so many vendors with essentially the same offerings, it isn't hard to figure out why PC prices have plummeted in the past three months. Industry leaders IBM, Apple, and Compaq all slashed prices by up to 35% since last year to steal market share from the lower-priced products from second- and third-tier clone makers. In turn, the clone makers have, themselves, been trying to boost market share at the expense of margins. And since customers see they can get essentially the same products—in some cases, better—at lower prices, top-tier companies had no choice but to react. But those price cuts mean dramatically lower gross profit margins, signaling either a slowdown in hardware development or serious consequences to the bottom lines of each of the three industry leaders.

Meanwhile, second- and third-tier companies that have been beating IBM and Compaq out of commercial accounts (such as AST Research and Dell Computer) must also lower prices. That puts more pressure on already tight margins and threatens the ability to compete mainly on a lower-price basis.

Of the several dozen vendors now testing the waters of the $36 billion PC marketplace, two kinds of vendors are likely to survive the price bloodletting: those that find markets for PC innovation and those that can build at the lowest costs (which typically means the highest volumes). In both cases, survivors must have distribution schemes that rely less upon commercial distributors and more on direct sales and so-called computer "superstores."

Spring Comdex highlighted another subtler facet of the PC marketplace—the presence of an ever-higher number of Asian vendors in the United States. If manufacturing is, indeed, a cornerstone to success in this systems market, U.S. vendors haven't seen anything yet.

—By Dave Webb

SOFTWARE

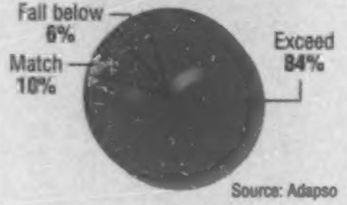
Software execs upbeat on economic outlook

UNLIKE OTHER SEGMENTS of the computer industry, where executives are wringing their hands, cutting prices, and laying off employees, software company executives expect to show financial gains this year over 1990.

A survey of 380 software company CEOs and CFOs conducted in March by Adapso, an Arlington, Va., computer software and services trade as-

Optimism reigns among software vendors

Software executives' expectations for fiscal 1991 revenue over 1990



Source: Adapso

sociation, found that 84% of them expect 1991 sales and profits to exceed last year's. "As a whole, the software industry is moving ahead despite the current economic slowdown," says Douglas Jerger, vice president of Adapso's Software Industry Division.

The survey did indicate that things are not as good as they could be. Fifty-eight percent of the respondents said the current economic climate would affect them "somewhat negatively," while 42% said customers are taking longer to pay for products and services. The survey also disclosed that vendors of microcomputer software are faring much better than those who market software for minicomputers and mainframes.

Sixteen percent of the responding executives said they expect their company to undertake some cost-cutting measures this year. Of those, 41% plan to cut staff and 37% plan to cut advertising and marketing-related expenditures.

—Rick Whiting

OPERATING SYSTEMS

Will Apple's System 7 block the Windows onslaught?

APPLE COMPUTER'S history of crying wolf over the arrival of its System 7 Macintosh operating system took a lot of steam out of the system's actual debut last month. Apple began talking publicly about System 7 in 1989, and has since pushed back its delivery date several times.

Now that it's here, there are concerns that Apple is too late to stem the tide of Mac users converting to Windows-enabled, user-friendly PCs. Microsoft's success with Windows 3.0 has been nothing short of spectacular, forcing that company to recalibrate its OS/2 commitment and spawning an epidemic of new Windows-based DOS applications.

System 7, for its part, doesn't appear to have the installed-base leverage of Windows, and not only because the sheer numbers of DOS machines dwarf the Macintosh installed base. Since many older Macs aren't easily upgraded to System 7, it could prove ineffective as a sandbag to stop any significant flow of conversions to cheaper, applications-rich Windows-based PCs. Among other things, System 7 requires a hard disk drive and at least two Mbytes of RAM.

Still, System 7 is a hefty weapon for Apple. By fall, several applications from top-name software vendors—Microsoft, Venture Software, and T/Maker—will have System 7-optimized software packages on the market. The Windows tide may be cresting, but Apple will have to prove that System 7 is more than just a sandbag.

—By Dave Webb

COMMUNICATIONS

Hotels get low marks from laptop users

WITH LAPTOP computers becoming as popular and easy to use as car phones, executives on the go can now log on with the home office from just about anywhere—anywhere, that is, except the average hotel room. In fact, less than 40% of hotel rooms in the United States are "modem ready," according to a survey by the Association for Computer Training and Support.

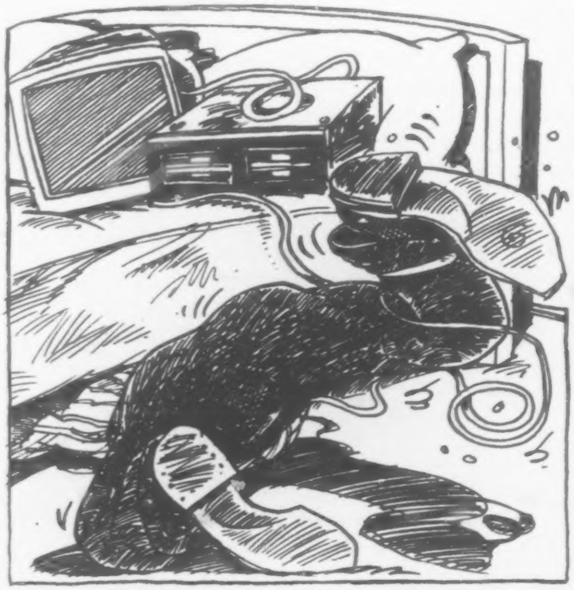
As a result, says ACTS director Elliott Masie, data-starved managers on the road often must resort to their own wits and engineering skills to plug themselves into hotel phone systems. One survey respondent claims to routinely spend about an hour moving beds and dressers, taking phones apart, and crawling around on the floor to open up baseboard outlets. Another once had to run a phone line down the hall and into a storeroom to find a line that didn't go through the front desk. Yet another had to call for help when he became wedged under the bed while hooking up his computer.

Worse yet, says Masie, only 2 out of 15 chains can identify which of their hotels have modular plugs in the rooms. Interestingly, economy chains such as Red Roof and Budget-Tel seem to be better informed on the subject than such biggies as Hyatt and Holiday Inn.

ACTS has requested that all U.S. hotel chains provide travel agents with information on the modem capabilities of each of their properties by year-end. Masie also has "challenged" the chains to install modular plugs or adapters in every room by the end of 1992. In the meantime, ACTS suggest that business travelers carry an "emergency kit," including a screwdriver, phone extension cords, and alligator clips.

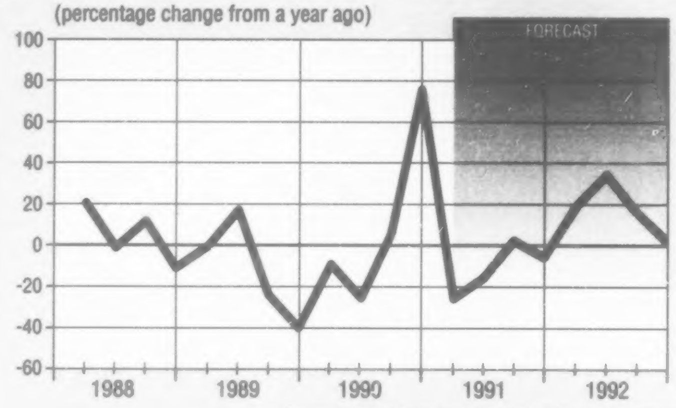
For a free copy of the ACTS report, *Traveling with a Laptop Computer*, send a stamped self-addressed envelope to ACTS, 27 Sagamore Rd., Raquette Lake, NY 13436.

—H. Garrett DeYoung



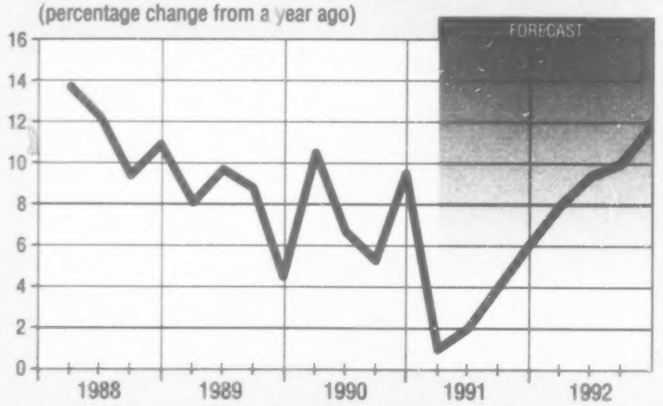
BUSINESS BAROMETER

Electronics profits take a hit in early 1991...



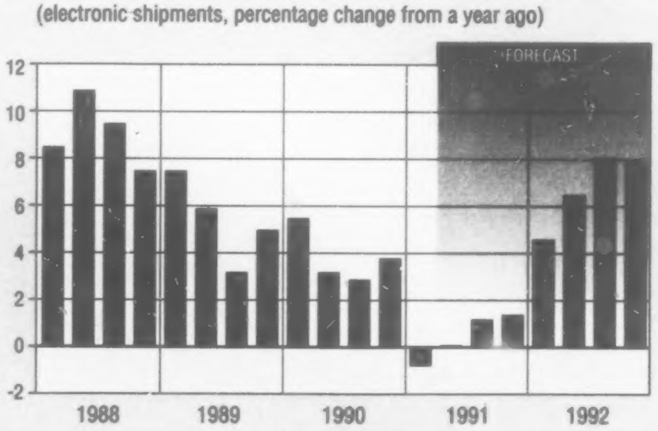
Source: Electronic Business; forecast: Cahners Economics

...as revenue growth slows dramatically...



Source: Electronic Business; forecast: Cahners Economics

...but relief is in sight for 1992



Source: Commerce Dept.; forecast: Cahners Economics

Profits plummet now but will recover in '92

FOR EVERY UPTURN, there is a downturn. That has never been truer for the electronics industry. After soaring 79% in the fourth quarter of 1990 compared with a year earlier, profits headed south in early 1991. According to ELECTRONIC BUSINESS's composite profits index, company profits on average fell 25% below year-ago levels in the first three months of this year. Discounting the seasonal trend in profits, the latest slump is in response to slow sales.

Total shipments of U.S. electronics products fell 0.8% in the first quarter below the same period last year, the first decline recorded since the electronics industry recession in the fourth quarter of 1986. Digital Equipment Corp.'s analysis sums it up best: "The difficult economic environment is still with us. An uncertain business outlook, heightened by the Middle East conflict, is causing delays in customers' investments in technology, particularly for large systems."

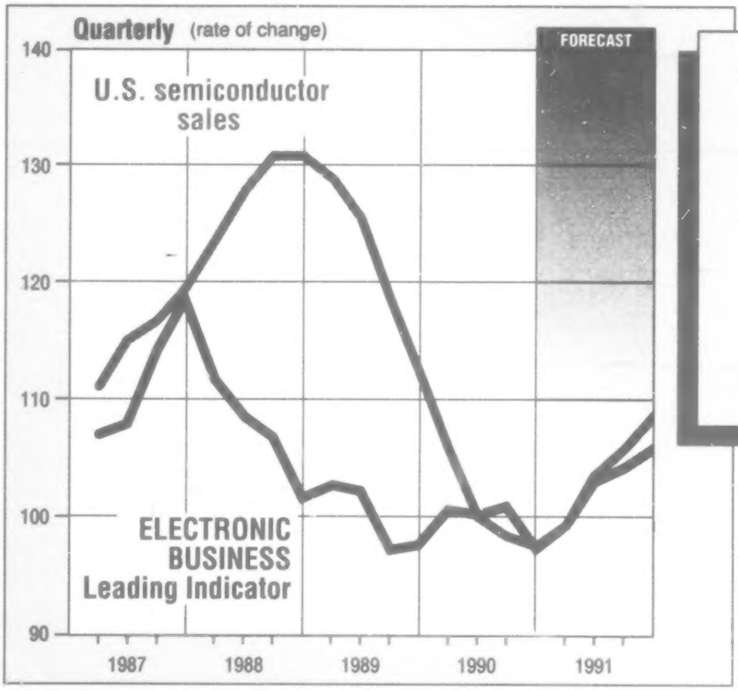
When can electronics companies expect a rebound in profits? Soon, if the EBLI continues on its upward path. Further, while domestic orders for electronics remained weak, most companies report gains abroad, which should help sustain earnings until an expansion resumes at home. Meanwhile, electronics companies are reporting more restructuring and labor cuts to reduce operating costs, the benefits of which will emerge in 1992 when profits are forecast to rise 15.5%, in contrast to a decline of 9.6% in 1991. For every downturn, fortunately, there is an upturn.

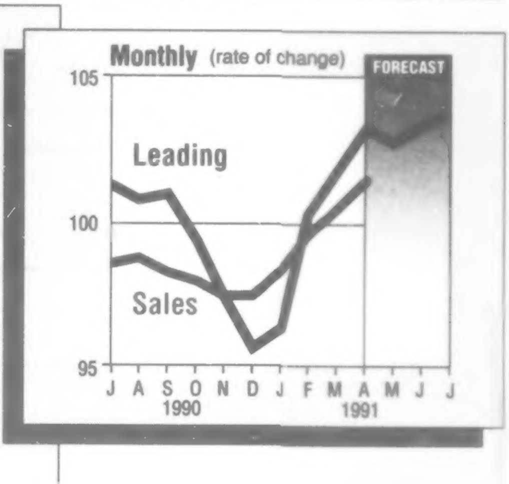
—John Farrell

For more information on Cahners Economics, contact Dan Buchan at (617) 630-2105, by fax at (617) 630-2100, or write Cahners Economics, 275 Washington St., Newton, MA, 02158-1630

BUSINESS BAROMETER

ELECTRONIC BUSINESS Leading Indicator confirms recovery in April



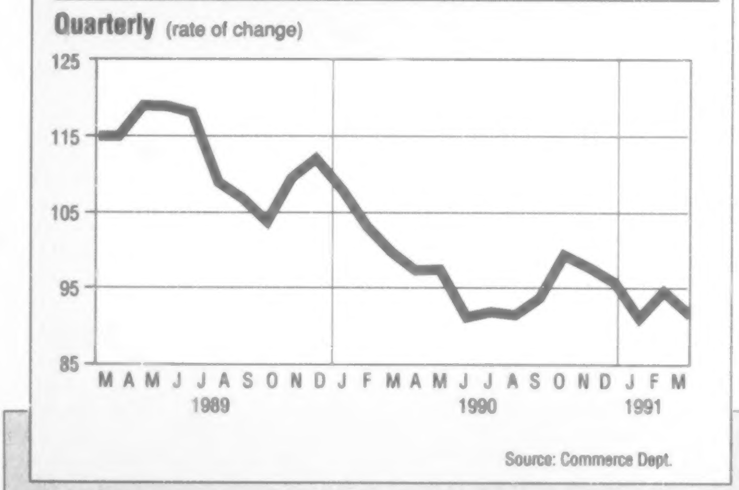


Leading indicator gains strong foothold in April

THE ELECTRONIC BUSINESS Leading Indicator climbed from 101.7 in March to 103.2 in April. The strong showing clearly points now to a recovery ahead in the electronics industry. All components of EBLI rose in April except contracts and orders for new plants and equipment. Cahners Economics predicts EBLI will rise slowly to a new peak of 109.5 in June 1992.

EBLI is a weighted composite of six statistics that tend to lead activity in the electronics industry. To obtain your complimentary background paper, contact Cahners Economics, 275 Washington St., Newton, MA 02158-1630, USA; telephone (617) 630-2119; fax (617) 630-2100.

Plant and equipment orders remain weak

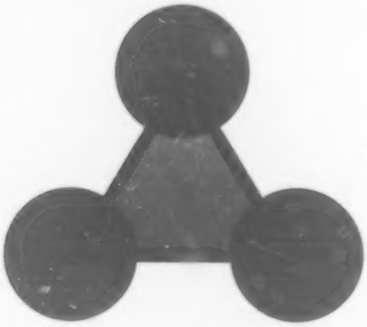


Source: Commerce Dept.

	Latest month	Previous month	Year ago	1990 average
ELECTRONIC BUSINESS Leading Indicator (rate of change, Apr.)	103.2	101.7	100.1	99.8
U.S. semiconductor bookings ($ millions, 3-month average, Apr.)	$1,448	$1,363	$1,366	$1,254
Weekly hours of semiconductor production workers (monthly average, Mar.)	41.1	40.1	40.1	40.4
Electronic components lead time index (1977 = 100, May)	93.3	88.6	87.3	80.7
S&P's semiconductor stock price index (1970 =10, monthly average, Apr.)	74.8	70.6	67.8	64.6
Change in electronic components inventories ($ millions, SA, Mar.)	-$23	-$207	$112	$33
Contracts and orders for plant and equipment ($ billions, SA, Mar.)	$33.4	$37.3	$41.3	$38.2

SA = seasonally adjusted; all other data are not seasonally adjusted

Sources: Semiconductor Industry Association, Bureau of Labor Statistics, *Electronics Purchasing*, Standard & Poor's, Commerce Dept., Bureau of Economic Analysis



New alliances promise to reshape the desktop

Among its other goals, the ACE consortium is seen by some as a move to "get Sun and keep Intel honest"

By Teri Sprackland

So far, the Advanced Computing vironment (ACE) alliance, wh some proclaim as the opening in the battle between PC and wor station contingents, has been lit more than a war of words.

"Those who can, do. Those who can't, sort," said Scott McNealy, CEO of Microsystems Inc., the Mountain View, Cal based workstation leader. At the Hambre and Quist Technology Conference in San Fr cisco, ACE was dismissed by at least source as just another "rite of spring," a ref ence to a long line of generally ineffective dustry groups. The consortium was seen an effort by Compaq Computer, Digital Equi ment, Silicon Graphics, Microsoft, Mips Co puter Systems, and others to "get Sun keep Intel honest."

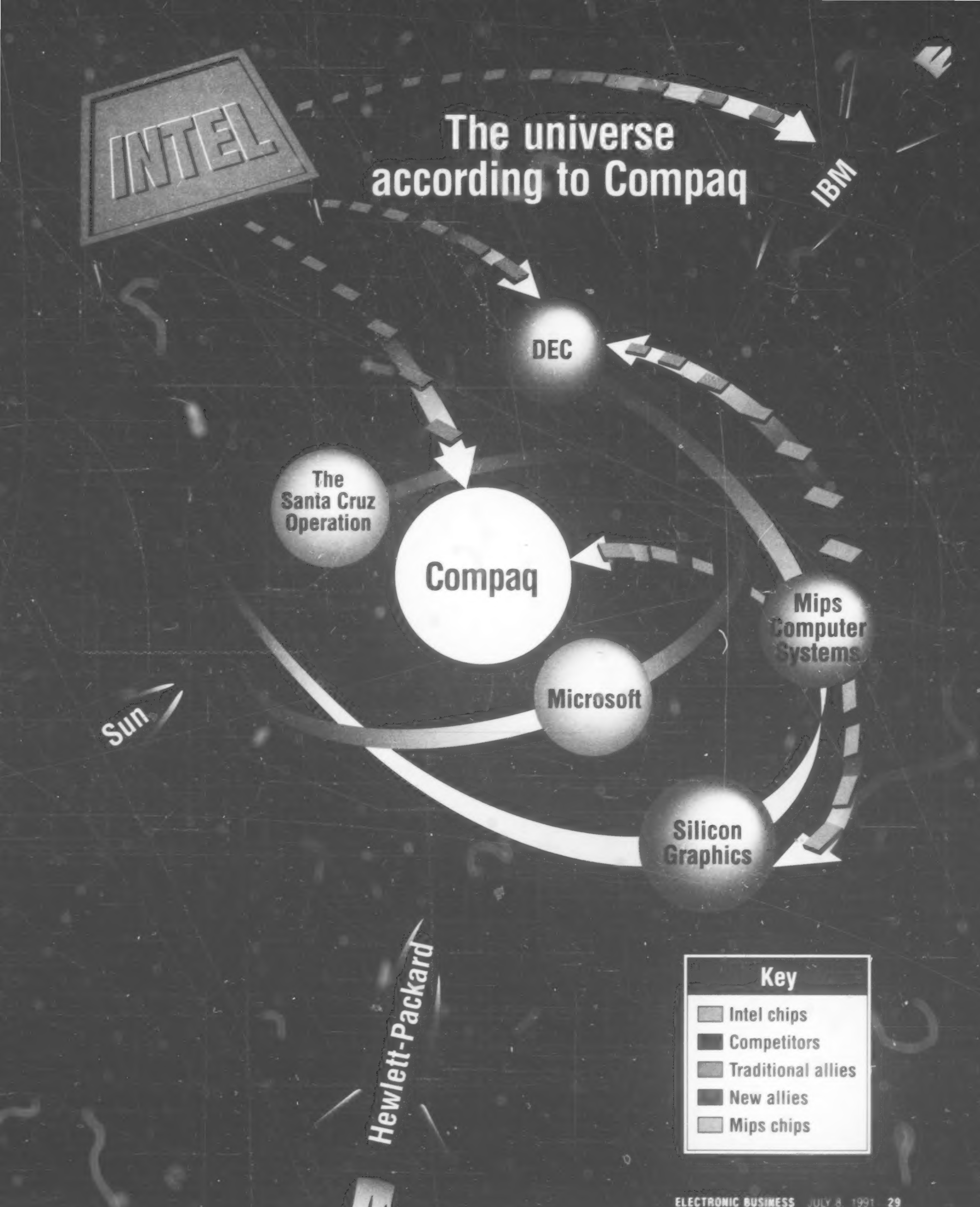
Those comments acknowledge two facts life that now characterize the electronics dustry. The first is the bridging of the technical and marketing gaps that have long separated PCs and workstations. The differences between the two classes of machines range from the arcane to the obvious, but a fundamental similarity is emerging: Both are designed to be used by

Financial orbits

The ACE initiative has restructured a tang of suppliers, competitors, and customers. Compaq's oldest allies still remain close, b new allies are now in closer orbit. Watching closely from the outside is Intel, which remai a chip supplier to both sides. Competitors Sun, and IBM, however, are aiming to blo a few holes in Compaq's universe.

Equity stakes provide gravitational pull ACE members:

- DEC holds a 5% stake in Mips;
- Compaq holds a 13% stake in Silicon Graphi
- Microsoft holds a 20% stake in SCO.


INTEL
The universe according to Compaq
IBM
DEC
The Santa Cruz Operation
Compaq
Mips Computer Systems
Microsoft
Sun
Silicon Graphics
Hewlett-Packard
Key
Intel chips
Competitors
Traditional allies
New allies
Mips chips

Consortium founders: Microsoft's Gates, Compaq's Canion, Mips's Miller, DEC's Olsen, and SCO's Michels

viduals at their desks.

The second fact of life is the growing discomfort among microprocessor users held virtually captive by Intel Corp. To be strategically vulnerable to one supplier—who not only may establish pricing and availability but who also owns a thriving systems business—makes PC manufacturers understandably nervous. Even Compaq, despite its place at the head of the top tier of Intel's customers, has long been known to feel an occasional twinge at Intel's role as Compaq's sole microprocessor supplier.

BASICALLY, ACE specifies an interoperable, multiple-platform hardware/software scheme. If all goes as planned, ACE will allow users to mix and match ostensibly standardized systems from ACE-compliant vendors of Intel 80x86-based PCs, DOS or OS/2 PC operating-system applications, Unix applications, and RISC (reduced instruction set computer) system hardware based on Mips Computer Systems' RISC microprocessor. ACE's RISC workstations would run any of thousands of today's software packages in millions of DOS and OS/2 PCs. And Intel 80x86-based PCs could run engineering and graphics applications designed to run on Unix-based workstations such as those designed with the Mips RISC microprocessors.

That flexibility makes ACE "one of the most important things that has happened in the [computer] industry," says Silicon Graphics CEO Edward McCracken, since it would leave no one vendor a dominant market force. It also is a step toward what the industry has been rhapsodizing about for years: truly open systems.

The war of the words is bound to heat up. Sun is aggressively and successfully besieging the commercial market, which until now bought minicomputers or PCs. The workstation, in other words, is not just for engineers anymore. PC maker Compaq, meanwhile, bought an equity stake in Silicon Graphics, which is highly regarded for its capabilities in 3-D graphics workstations, giving Compaq expertise in a totally new area. In the process, Compaq also bought into Mips Computer Systems' part of the RISC world because Mips provides chips to Silicon Graphics. Compaq would have been happy to acquire Silicon Graphics lock, stock, and barrel and may later try to increase its holdings.

Compaq certainly needed an upward migration path to escape the price pressure in the clone market. Indeed, shortly after the ACE consortium was announced, Compaq cut its prices then announced reduced quarterly earnings.

There were other RISC architectures from which Compaq could have chosen—primarily, the Sparc architecture, which is promoted by Sun and which dominates the RISC market. Compaq could not, however, be expected to buy its bullets from the enemy camp. Licensed to multiple silicon vendors for manufacturing, Mips's well-regarded architecture gives Compaq access to volume production at competitive pricing with a quality image.

Mips, itself, is seen as having concluded a major coup with ACE; the company was losing ground to Sparc and could have ended up with little more forward momentum. Now that Compaq has jumped, Mips's silicon vendors are cheering as they hear the telephones ring with calls from other PC vendors. However, Mips has not yet succeeded in emerging beyond its role as premier architecture licenser to gain recognition as an OEM systems house. In that endeavor, DEC's stake in Mips may be both a blessing and a curse. DEC has provided money and a home for a specially engineered version of Mips's chips, but DEC can reason-

How Wall Street sizes up ACE

The bulls and the bears are running rampant on Wall Street as financial analysts assess the market impact of the ACE initiative. Here's what a few prominent analysts have been saying:

Thomas P. Kurlak,
Merrill Lynch Capital Markets

⬆ "Ace will be a major success," says Kurlak, Merrill Lynch's semiconductor expert. "It is being panned now, but that is a knee-jerk reaction by people who just haven't done the analysis."

Kurlak predicts success for ACE for several reasons. First, Microsoft's involvement is a big plus. Second, "both Gates [CEO of Microsoft] and Canion [CEO of Compaq] say they are interested in ACE to provide an upgrade path for their customers," and the idea of listening to the customer could motivate the success of ACE. Finally, adds Kurlak, the desktop market is becoming saturated and even users of 486-based PCs are looking at workstations. "With ACE, customers won't have to compromise their software investments," explains Kurlak. "Everyone wins with ACE. Software makers win, customers win, and hardware makers win. That is why ACE will succeed." ☐

Mark D. Stahlman,
Alex, Brown & Sons Inc.

⬇ Stahlman is a bit more pessimistic about ACE. "Most of the companies involved in ACE have their own agendas," says Stahlman. "What they all have in common is that they currently have small roles to play in the new growth industry—workstations. Each is being forced to play catch-up. That is never a good place to be." He notes that the ACE players will never achieve a dominant role, so they must determine their secondary roles and positions for the eventual shakeout in the workstation market that will occur in 1995 or beyond. Who will lose under ACE? "The entire PC industry," claims Stahlman. The most important thing about the ACE initiative, he says, "is what it tells us about current sales patterns and customers' wants. The move to open systems is continuing to build momentum." ☐

Laura Conigliaro,
Prudential-Bache Capital Funding

⬆ Conigliaro keeps Sun Microsystems in the win column in her assessment of ACE, at least in the short run. "I have absolutely nothing bad to say about Sun," she says. "The ACE announcement is an affirmation of their highly successful strategy." Other winners include ACE participants Silicon Graphics, "because they now have lots of cash with which to do lots of different things," and Mips Computer Systems. Without ACE, says Conigliaro, "Mips would have had to rethink their business strategy entirely. With ACE, their business model stays intact and has credibility and a foundation that it didn't have before." As for losers, Conigliaro agrees with Stahlman that PC makers have the most to lose. If ACE is successful, PC makers will see lower margins and a cut in revenue growth potential. "Distributed computing is going to be a very crowded market," she says. "Digital Equipment, Hewlett-Packard, and other companies that haven't built up enough momentum are at greater risk over the long term." But, Conigliaro qualifies, the PC market will not be impacted greatly by ACE in the short term. The problems for PCs will loom larger two or three years down the road. ☐

Mel Phelps,
Hambrecht & Quist

⬆ Here's the first take on ACE winners and losers from Hambrecht & Quist as reported in the company's Apr. 17 report: Winners include Compaq Computer because "the application portability between the Mips and Intel environments should yield a more favorable component pricing landscape for Compaq and others." Mips Computer Systems is "the big winner" because the ACE initiative offers potential for high unit volume sales of processors that did not exist before ACE. Silicon Graphics, as a technology enabler for both Compaq and Microsoft, also makes it into the win column because "the agreements provide significant incremental revenue to Silicon Graphics."

Potential losers under a successful ACE environment include Digital Equipment, Sun Microsystems, and Intel (the "major loser"). Says the Hambrecht & Quist team, "The highly likely success of ACE will make it more difficult for Sun to penetrate the commercial market." However, "even a modest penetration of the commercial market would make a significant incremental contribution to Sun's growth as the market is much larger and commercial sales account for only 15% of Sun's current sales." So Sun may lose some growth potential under a successful ACE deal, but not enough for Hambrecht & Quist to downgrade Sun's stock.

—Elizabeth B. Baatz

ACE participants

The worldwide leaders in the computer systems market participating in the initiative include:

- The Acer Group
- Compaq Computer
- Control Data
- Digital Equipment
- Kubota Computer
- Microsoft
- Mips Computer
- NEC
- NKK
- Olivetti
- Prime Computer
- Pyramid Technology
- The Santa Cruz Operation
- Siemens AG/Automation
- Siemens Nixdorf Informationsysteme AG
- Silicon Graphics
- Sony
- Sumitomo Electric
- Tandem Computers
- Wang Laboratories
- Zenith Data Systems

ably be expected to have a strong influence on Mips's future in the systems business, DEC's home turf.

Most of the other participants in the original ACE announcement are refugees from a dying minicomputer market. Companies that have built strong sales and support teams around proprietary minicomputer sales may be salvaged if their executives can core out the outdated proprietary innards and transplant in new open systems architectures that customers now demand.

THE DEBATE ABOUT who will win in the ACE consortium will go on for some time. The survival of ACE itself, however, will depend largely on how DEC and Compaq maintain their separate market orbits. Only a few weeks after ACE's birth, DEC teamed up with Intel to introduce a "PC workstation" family, a move hardly conducive to Compaq's peace of mind. Intel is, once again, competitor and supplier.

Another competitor in the workstation market is Hewlett-Packard Co., which has moved beyond the minicomputer attitude prevalent in earlier years to capitalize more successfully on its RISC architecture. HP had earlier introduced one of the first commercial RISC operating systems but had not exploited that market; in the end, it is not so much the technical brilliance of an architecture that counts, but its successful commercialization. Most of the existing high-end operating systems and chips were developed by a core group of engineers who have migrated from one company to another over time.

While hardware vendors hope to convince users that their computers are faster, and chip designers in turn try to convince computer manufacturers that their RISC chip is easier to incorporate into their designs, many industry insiders say that the technical superiority isn't what will make or break ACE. "Many of the same people worked on the Mips architecture, HP Precision Architecture-PA, and Sparc, so they are all good," says a high-level systems developer who was instrumental in creating HP's RISC architecture. All of these implementations are good enough to become the standard, he adds, but volume, price, marketing, and hardware applications will determine who wins out.

The final element of the ACE consortium is the impetus coming from the software market. The involvement of Microsoft is utterly crucial to the success of Compaq's crossover strategy. Microsoft has successfully grown its stake in the computer industry to the point that its success has, to some extent, overshadowed that of its far mightier partner, IBM. Indeed, there is evidence of growing strain in that relationship as Microsoft forges ahead with its own operating systems. IBM is also a competitor to many within ACE, both on the RISC workstation and on the PC side of the equation. Microsoft owns an equity stake in The Santa Cruz Operation, the privately held company charged within ACE with the monumental task of bridging the operating system gap between the DOS world of the PC and the Unix world of the workstation.

Yet even mighty Microsoft cannot meld the PC and workstation software markets without the cooperation of independent software developers, "the king makers of the future," according to Roger Ross, CEO of Ross Technology, a subsidiary of Cypress Semiconductor that makes and markets Sparc chips.

All in all, the ACE consortium is a motley bunch, consisting of companies small and large, successful and struggling, private and public. Chips, systems, and software businessmen alike are all seeking combinations to a puzzle that will unlock market growth, and they are willing to shake hands with old enemies or infuriate old allies to do it. There's no lack of opinion about who will win and who will lose. Only one vision really emerges: No one is going to see the computer industry in quite the same way again.

—Additional reporting by Lisa Stapleton

The battle for the desktop

As Compaq, Sun, and others look for new markets, the line between workstations and PCs gets even blurrier

By Dave Webb

When Compaq Computer Corp. CEO Rod Canion realized two years ago that PCs alone could no longer sustain the company's stellar growth record, he revised Compaq's strategy by targeting a wider swath of the commercial systems market. And when Sun Microsystems Inc. CEO Scott McNealy came to see last year that Sun's technical-workstation market was similarly restricted, he set out to chart a new market based on commercial applications.

Those decisions have put the two players in OEM desktop computers on a collision course. Hoping to restore blistering revenue growth and fat profits, each is eyeing the other's technology with the intent of combining and leveraging them to address the feverish demand for interoperable, open systems. The result: The line between workstations and PCs is becoming even blurrier.

By moving into workstation architectures, Compaq CEO Rod Canion expects that the company will eventually double in size

Compaq's RISC (reduced instruction set computer) strategy is now clear: The company is navigating beyond the hotly competitive, commodity-bound PC market by heading up a group of system hardware, software, and chip companies that have pledged allegiance to a desktop computing standardization plan known as the Advanced Computing Environment (ACE) initiative.

But Compaq's foray into higher-end commercial systems markets could be derailed. The initiative is disheveled in its specifics of software standards compliancy. Independent software developers are reluctant to start on ACE-compliant application packages simply because the initiative doesn't designate a single operating system. Digital Equipment Corp. supports its Ultrix version of Unix, for example, while Silicon Graphics Inc. will support its own operating system; and others drift toward support of Unix System V.4. Likewise, developers must worry about whether to develop applications for OS/2 2.0, which isn't available yet, or begin working on Windows 3.0 applications, though it isn't clear how much support Microsoft will give ACE through Windows.

THE NEW RULES of the desktop game aren't limited to Compaq and Sun. Vendors from both the $36 billion PC market and the $7.3 billion workstation market also are shifting strategies to accommodate high-end commercial accounts, largely in response to revenue-limiting dynamics of their respective markets. Two months ago, for example, DEC announced a new line of PCs based on Intel Corp.'s 80486, with workstation-equivalent graphics capabilities. Until that time, the main distinction between workstations and PCs was that the former were powerful enough to easily handle complex graphics, particularly in three dimensions. (Interestingly, at DEC's May press conference, their PCs displayed "PC Workstation" on their screens.)

Compaq's migration into the RISC world appears to target commercial mainframe and minicomputer users who might replace those larger, more expensive systems with cheaper, almost-as-powerful networked desktop systems. The idea is to leverage not just existing investments in older systems, but also the mindsets of users who are used to working with Unix rather than Microsoft's DOS. "You have to accommodate not only the installed base, but history, in a sense, because of the commitment to different existing operating systems and application platforms," says Canion. "Customers have invested in Unix as solutions and aren't going to switch to PCs. They are committed to one or the other."

Digital Equipment at a glance

Sales (millions)	$12,943
Profits (millions)	$74
Cost of goods/sales	52.5%
R&D/sales	12.5%
Capital expenditures/sales	7.9%
Employees	124,000

All figures for fiscal year ended Jun. 30, 1990

Source: Company reports

Compaq wasn't seeking a RISC solution when the company embarked upon the plan to target large commercial accounts. "Our path led us to RISC," says Canion. "We began to learn what customers were really looking for in commercial systems applications, and it involved going beyond just PCs."

But ask anyone at Sun if they are worried about ACE, and you're likely to get a shrug. "I don't see this as a tangible threat," says Bill Keating, Sun's director of corporate technology marketing, who says that ACE is similar to the "rhetoric" surrounding the Open Software Foundation's standards initiative in 1988. "OSF backed down from those objectives," he says, and he expects similar disunity among ACE participants.

Sun has made it clear in the past year it means to use its own RISC architecture (called Sparc) to target high-end commercial application markets with a missionary zeal. The company has already grown commercial revenues to more than 30% of total sales. But because Sun faces competitive pricing at the high end, as well as the low end, of the workstation market (IBM chopped RS/6000 workstation prices, for example, and Hewlett-Packard's price/performance campaign portrays Sun as offering less bang for the buck), Sun may be forced to cut prices or unveil new higher-performance products.

Keating shrugs off the competitive pricing heat. "All we want to do is keep prices at the same level while continuing to offer new generations of products with higher and higher performance," he says. "That's all customers really ask."

Other Sparc proponents claim that ACE simply validates the direction in which Sun and Sparc International were already guiding the marketplace with their open, licensable architectures and interoperability. Sparc International chairman Bob Duncan says there are over 3,000 shrink-wrapped applications that run on Sparc, and many are non-technical applications popular with DOS PC users. Lotus Development Corp.'s 1-2-3 spreadsheets and WordPerfect Corp.'s word-processing programs have been ported to Sun OS (the operating system licensed through Sun's recent Sunsoft Inc. spinoff). More than 30 system vendors, mostly Asian, are now manufacturing and marketing Sparc-compatible products. Less than a dozen vendors are marketing OEM systems based on microprocessors from ACE player Mips Computer Systems.

Compaq Computer at a glance

Sales (millions)	$3,599
Profits (millions)	$455
Cost of goods/sales	57.2%
R&D/sales	5.2%
Capital expenditures/sales	9.0%
Employees	11,400

All figures for fiscal year ended Dec. 31, 1990

Source: Company reports

THE ACE INITIATIVE generates a certain credibility by virtue of its membership: Among its 21 core supporters are DEC, Microsoft, Mips Computer Systems, Acer Inc., Silicon Graphics, The Santa Cruz Operation (which is making the DOS-to-Unix portability largely possible), Tandem Computers, NEC Corp., Zenith Data Systems/Groupe Bull, Sony, Siemens Nixdorf Informationssysteme, Pyramid Technology, Wang Laboratories, and Prime Computer.

Still, some sources argue that the diversity will prove to be a handicap. "How can anyone develop anything when the ACE principals can't agree on a single operating system?" asks Duncan. DEC already claims ACE compliance with its latest generation of Series 5000 workstations designed around Mips's R3000 chip. Fully compliant products from DEC and others based upon ACE specifications aren't expected until 1992 at the earliest.

IBM at a glance

Sales (millions)	$69,018
Profits (millions)	$6,020
Cost of goods/sales	44.5%
R&D/sales	9.5%
Capital expenditures/sales	9.4%
Employees	373,816

All figures for fiscal year ended Dec. 31, 1990

Source: Company reports

The initiative

Getting ACE into the customer's hands

IN THE BATTLE for sales, selling a PC is a quick strategic strike, says Seymour Merrin, a distribution analyst and president of Merrin Information Services Inc. in San Francisco. PC dealers make a fast foray into the market and offer the lowest price possible; the consumer either buys from that dealer or walks down the street to the next one.

On the other hand, selling workstations is more like laying a siege. "You have to camp out on the customer's doorstep in order to fight off competitors," Merrin says. A workstation reseller often has to have networking expertise, the ability to tie in the new hardware with customers' previously purchased units, and, finally, the capacity to integrate specialized software to produce a total solution for a corporate customer.

Setting up distribution is a particularly acute problem for ACE members such as Compaq Computer Corp., Zenith Data Systems Corp., and Acer Inc. All three traditionally have sold their PCs through dealers and distributors, and they lack the experienced resellers that are available to workstation vendors.

AS A RESULT, ACE strategists are trying to divine the best method for getting their workstations into the hands of customers. In general, they have only two options: Either they must bring their storefront dealers up to speed in terms of selling higher-end products, or they must align themselves with new partners who are already experts in workstations.

With ACE-based products scheduled to appear in 1992, however, the PC-oriented companies don't have much time to become experienced workstation vendors. Xavier Candia, manager of channel development at Sun Microsystems Inc., knows firsthand the difficulties that Compaq and other ACE members will have using PC resellers to sell workstations.

"It requires a lot of investment in training and creating a support infrastructure for the dealers out there," according to Candia, who has spent the past five years building a distribution network for Sun. It can take from 6 to 12 months to get a reseller sufficiently trained to sell workstations, he says. It also takes time to find the few good VARs and dealers capable of making it through such grueling basic training.

Sun's Candia: Using PC resellers to sell workstations is tough

Moving up to begin selling workstations is hard work for any dealer. The Businessland Inc. chain, for example, has sought to transform itself from a pusher of stand-alone PCs into a deliverer of value-added networking and systems integration services. But it has been a painful process. The retail chain has had five consecutive quarterly losses during the transition.

If ACE products appear in 1992, PC vendors won't have time to become skilled workstation vendors

Nor can most computer dealers, with their razor-thin margins, afford to invest today for sales tomorrow. ACE members wanting to set up adequate distribution for their new products are going to have to invest time and money in helping their retailers.

Spurred on by such critiques, Compaq started improving the support that dealers give to their customers even before the ACE announcement. In February Compaq announced a Specialized Dealer Program designed to identify dealers for those customers that require advanced connectivity solutions. Instead of handing out a list of local dealers for a potential customer, the company recommends those specialized dealers when customers require more complex solutions.

TO BECOME A MEMBER of this subset of Compaq's authorized dealers, a reseller must have achieved an advanced designation from one or more of the PC network software companies (Novell, SCO, Microsoft, Banyan), have a Compaq-accredited systems engineer on staff, offer on-site service and support, and carry a specific inventory level of Compaq equipment.

As of May, Compaq had signed up about 40 of its estimated 400 U.S. dealers for the program, and the company projects that it will authorize about 20% of its dealers by year-end, says Doug Johns, Compaq's vice president of corporate marketing.

While Compaq says it is only in the process of drawing up distribution plans for its ACE products, Johns does say the company will be pragmatic and flexible. "We recognize that the model of distribution we used in the '80s may or may not be exactly the right model for the '90s," he says. "We are going to be open in our approach. This is *terra incognita* for us."

—By Jenny McCune

has solidified a large chunk of the nonproprietary RISC workstation market opposite the Sparc clone contingent. IBM and HP, the other two significant workstation market shareholders next to Sun and DEC, don't license their RISC system architectures to the open market. While Sparc supporters scoff at the Mips coalition under ACE (which was largely in place before Compaq's April commitment to the technology), ACE vendors say Sparc is too rigidly controlled by Sun, especially through Sun OS.

"Sparc is Sun-dominated," says Edward McCracken, Silicon Graphics Inc.'s president and CEO. "We've never viewed Sparc as being really open. ACE is built around the Mips architecture, [and as a consequence] I think you'll see 50 to 100 companies adopting Mips in the next year."

ACE also promises to provide PC makers such as Dell Computer Corp. and AST Research Inc. (neither of which to date has announced support or alignment with ACE) an avenue of migration into ostensibly higher-performance yet similarly priced RISC-based systems. Since the only requirements ACE places upon companies wanting to conform are nondisclosure affidavits to platform specifications and a Mips RISC architecture license, PC market competitors such as Dell, AST, and Advanced Logic Research Inc. can easily become ACE players. They may have to make a commitment to RISC in other ways, such as adopting Sun's Sparc architecture.

Silicon Graphics at a glance

Sales (millions)	$420
Profits (millions)	$32
Cost of goods/sales	45.1%
R&D/sales	10.9%
Capital expenditures/sales	7.1%
Employees	2,099

All figures for fiscal year ended Jun. 30, 1990

13% equity owned by Microsoft

Source: Company reports

ACE certainly doesn't spell the end for Intel-based PCs, which are criticized for not having the graphics and multitasking capabilities workstations can offer at competitive prices. But ACE still assumes the viability of 80x86 as much as that of Mips's RISC architectures while promising users software applications that would run equally well on both platforms. "The mainline business in PCs is the Intel architecture," says Acer president Leonard Liu, "and it will continue to be so for a long, long time to come."

Hewlett-Packard at a glance

Sales (millions)	$13,233
Profits (millions)	$739
Cost of goods/sales	52.8%
R&D/sales	10.3%
Capital expenditures/sales	7.2%
Employees	92,000

All figures for fiscal year ended Oct. 31, 1990

Source: Company reports

But Allan Snell, Solbourne Computer Inc.'s vice president of marketing, believes the collision between PC and workstation architectures is likely to occur on Intel architecture turf, not in RISC workstation segments. The market for engineering applications is close to being saturated, leaving commercial applications the obvious field of battle. "There's going to be an overlapping of workstation and PC applications in the $5,000 to $10,000 arena," says Snell. "Unix is migrating to the PC world, not the other way around."

And PC market dynamics are a big factor in Compaq's expansion strategy. Compaq, like IBM, Apple, and several other PC vendors, had to do something to continue growth, and quickly. The PC market in the last half-year has become a hotly competitive, price-pressured market across all segments, even the rapidly growing one for notebooks. All of the major 80x86 PC vendors—IBM, Compaq, and a raft of others—have cut prices so aggressively that they are chewing up once-vaunted gross margins in the 60% range.

Sun Microsystems at a glance

Sales (millions)	$2,466
Profits (millions)	$111
Cost of goods/sales	56.7%
R&D/sales	12.2%
Capital expenditures/sales	8.6%
Employees	11,490

All figures for fiscal year ended Jun. 30, 1990

Source: Company reports

"Those days are gone," says Bill Lempesis, editor of the *Lempesis Report*, a PC industry newsletter in Pleasanton, Calif. "I don't see any segment of the PC market today being overly lucrative." Compaq itself cut prices up to 30% earlier this year, rolling out its new market share pricing strategy. Even Apple, which gained a reputation for cockiness over its ability to sell its Macintoshes at high prices and retrieve the highest margins in the business, is playing the price-competitive market share game. It rolled out cheaper, more functional versions of much of its existing product line last fall and has been falling over itself to keep up with demand ever since.

What this means is that PC manufacturers are faced with a commodity-style market that is likely to not only stunt company growth, but force a number of vendors out of the business. "A lot of them have already come to the conclusion that they just can't make any money in the PC market," Lempesis says.

Compaq's move into workstation architectures supports that hypothesis. Canion says Compaq projects a "big forecast of growth" as a result of targeting large commercial systems users. Short of predicting just what that means in quantitative terms, Canion expects to double the size of his company "over time."

"There is a lot of potential there. The PC market will continue to grow, and we expect many years of PC growth to come," Canion says. "[But] we view this as an opportunity for Compaq to grow in a newly emerging portion of the industry." ☐

RISC chips head for the mainstream

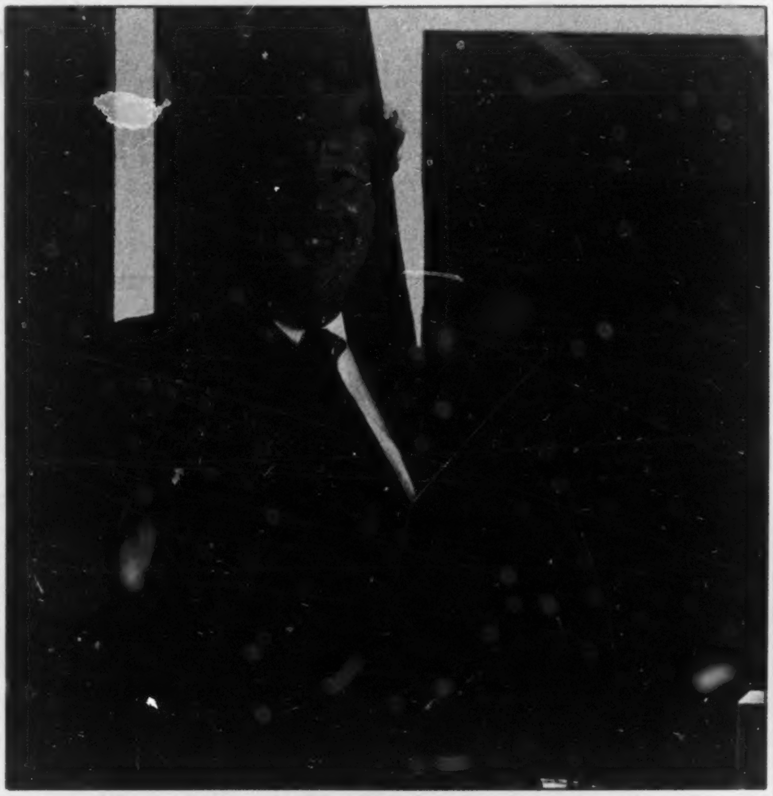
With ACE taking aim at its traditional dominance in microprocessors, Intel digs in to defend its position

By Teri Sprackland

One of the most logical questions surrounding the birth of the Advanced Computing Environment (ACE) alliance is how the young consortium may ultimately impact the nation's semiconductor makers.

The answer, not surprisingly, depends on who you ask. "[ACE] is a tempest in a teapot," scoffs David House, president of Intel Corp.'s Microcomputer Components Group in Santa Clara, Calif., in dismissing the importance of ACE's adoption of Mips Computer Systems Inc.'s reduced instruction set computer (RISC) architecture.

Other sources take ACE more seriously. "ACE is a slap in the face to Intel," notes Rikki Kirzner, senior industry analyst at Dataquest Inc. in San Jose. What ACE really signifies, she says, is that PC maker and ACE cornerstone Compaq Computer Corp. has recognized its need to grow rapidly into higher-performance workstations in order to evade its PC competitors and has embraced Mips's RISC architecture to do it. In essence, says Kirzner, Compaq has decided that "[Intel's] plans for next-generation 586 and 686 chips are great, but Intel isn't getting there fast enough."



Mips's president and CEO Robert Miller declines to specify future chips' direction, saying that "where we go from here is not clear"

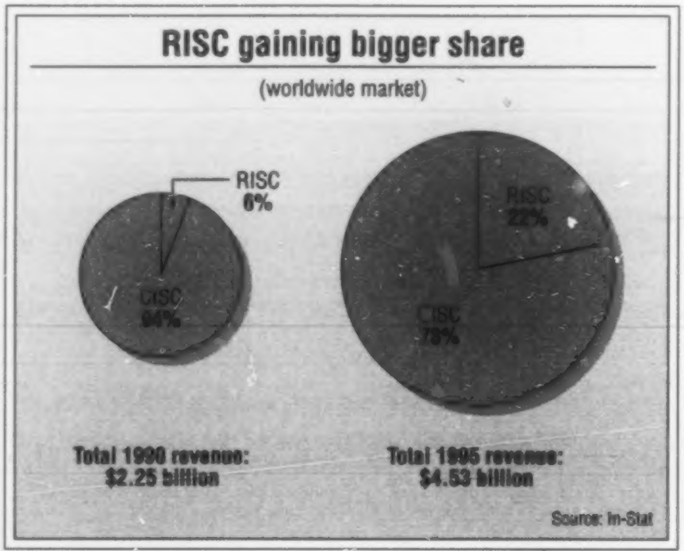
ACE participants tout their collaboration as one that allows PC and workstation makers to use either Mips's RISC architecture or Intel's popular 80x86 family of complex instruction set computer (CISC) chips. Despite House's breezy brush-off, that's a serious challenge to Intel, which until now has been the only PC microprocessor in town. Predictably, the company has already moved to put a few dents in ACE. Before the glow of ACE's April birthday party had faded, in fact, Intel CEO Andrew Grove was shaking

Mips Computer at a glance

Sales (millions)	$152
Profits (millions)	$7
Cost of goods/sales	44.2%
R&D/sales	18.3%
Capital expenditures/sales	16.9%
Employees	777

All figures for fiscal year ended Dec. 31, 1990
5% equity owned by DEC
18% equity owned by Kubota Corp.

Source: Company reports



RISC gaining bigger share

(worldwide market)

Source: In-Stat

hands in a new deal with ACE cofounder Kenneth Olsen, CEO of Digital Equipment Corp. The May move by DEC and Intel puts a new "PC workstation" product on the market, running on Intel 80486 chips and graphics components from DEC.

The ACE consortium is an effort to pull together a viable competitor to Sun Microsystems Inc.'s RISC microprocessor (called Sparc), says Roger Ross, president and CEO of Ross Technology Inc., a subsidiary of Cypress Semiconductor. He considers Compaq's choice of Mips's chip over Sun's as a reasonable business decision because of Sun's aggressive play for Compaq's high-end commercial market. "Compaq did exactly what I would do if I were competing against Sun," says Ross. "Sun is now on their horizon as a long-term threat. [In that situation], Sparc would not be my primary weapon or first choice."

ACE THUS REPRESENTS a move by Compaq and software giant Microsoft to see if the Mips architecture is a viable alternative to Sparc, says Ross. If it fails, he adds, "they will probably fall back on Sparc, or perhaps go to Hewlett-Packard. Neither [Compaq nor Microsoft] has burned any bridges." Given the growing success of Sun's RISC microprocessor, Sun represents something of a wild card for ACE. The company also has licensed its architecture to multiple chip vendors, such as Cypress Semiconductor and LSI Logic.

It isn't surprising that Intel's House would dismiss Mips as an alternative supplier, considering that there will be about 28 million Intel architecture systems in place this year, compared with only about 2,800 Mips architecture systems. According to Integrated Circuit Engineering Corp. in Scottsdale, Ariz., Intel will sell about 5 million 32-bit microprocessors (the 80386 and 80486 CISC chips) in 1991.

And ACE certainly will have little impact on the bulk of Intel's volume, since less than 5% of PC users will migrate into the workstation market, estimates analyst Kirzner. But while Intel would be happy to supply the world with microprocessors, not every customer is happy buying microprocessors from one source that can set its own price. Systems companies are looking for an upgrade path that doesn't lock them into one vendor. And if even 1% of PC buyers opt for workstations, the switch will double the current size of the workstation market, according to Michael Slater, editor and publisher of *The Microprocessor Report* in Sebastopol, Calif.

Today's systems companies want an upgrade path that won't lock them into one vendor

Intel and its managers are by no means standing still. A round of reorganizations was brewing within the company in May, with the responsibilities for various product lines changing hands. Once the dust has settled, a new management team could lead Intel in new directions.

Meanwhile, the faster 50-megahertz version of Intel's leading product, the 80486 microprocessor, is in the works, with industry sources looking for next-generation 80586 samples within the next year. Although House will not comment on specific developments, he notes that Intel does not plan to disrupt its 80x86 family with an incompatible RISC chip. Therefore, any new developments must be downward-compatible with chips that are over a decade old.

At the heart of the ACE consortium is Mips, the little company that keeps licensing its heart out. ACE has been a long time coming for Mips, which has been perceived as losing steam in recent months to surging sales of Sun's Sparc. Indeed, ACE may have kept Mips from fading into the background with a host of other RISC players.

"We started on ACE with Microsoft over two years ago," says Mips president and CEO Robert Miller. "We thought that whoever was going to win this microprocessor battle was going to have to win the PCs, and Microsoft was the clear leader in PCs." After Miller had worked out the game plan, Microsoft and Mips were able to sell the plan to both companies' customers.

MIPS IS STILL unsuccessful at establishing itself as a contender in the systems business, but the company's RISC architecture gets high technical marks. On the systems side, Mips uses its own chip design fabbed by its partners to build systems that are then sold on an OEM basis.

A key problem for Mips will be satisfying both its "big-endian" and "little-endian" architecture customers. The terms come from a tale out of *Gulliver's Travels*, about two countries that went to war over whether one should first eat the big end or the little end of an egg, and they refer to the the direction in which a microprocessor code is written (i.e., to support larger or smaller systems). Computers that use one system cannot understand computers that use the other.

Mips's architecture started out as big-endian but had to adjust to little-endian to provide chips to DEC. "That slowed down progress by a year and a half," notes Larry Jordan, vice president of marketing for Integrated Device Technology Inc. in Santa Clara, Calif., a longtime Mips semiconductor partner. And in its efforts to satisfy DEC, adds Ross of Ross Technology, Mips is trying to be all things to all people.

Mips's Miller declines to specify the direction for the company's future chips, saying that "where we go from here is not clear." For the moment, both options are available to customers. Mips's newest chip, the R4000, is about 90 days behind schedule, acknowledges Miller. He predicts that the first R4000 systems will be available by the first quarter of 1992.

VARIOUS OTHER FLAVORS of RISC abound, with many major semiconductor players in the market. Indeed, Motorola Inc. in Schaumburg, Ill., was once offered the opportunity to develop a RISC chip for Sun but stumbled in executing a successful early RISC strategy. Proponents of the Motorola 88000 RISC chip are now battling to regain recognition through the efforts of the 88Open industry group.

Intel's House contends that "SparcStations are replacing VAXs, not PCs"

The big remaining question is when or even whether Intel will climb aboard the RISC bandwagon. House suggests that there is little incentive for the company to do so, given that the two leading RISC camps are simply feasting on the carcass of a dying minicomputer market. "SparcStations are replacing VAXs, not PCs," House claims. Whatever the reasons that customers are buying Sun's SparcStations, it is indisputable that the machines are showing up in commercial accounts as well as in their original technical engineering accounts. Sparc vendor Ross notes "a major uptick" in recent chip sales, both directly from Sun and from emerging SparcStation clone makers such as Solbourne in the United States, ICL in Europe, and Toshiba in Japan.

The two leading RISC camps are feasting on the carcass of a dying minicomputer market

Intel at a glance

Sales (millions)	$3,921
Profits (millions)	$650
Cost of goods/sales	49.2%
R&D/sales	13.2%
Capital expenditures/sales	17.3%
Employees	23,900

All figures for fiscal year ended Dec. 31, 1990

Source: Company reports

Ross predicts that within three years Intel will lose market share but gain in volume chip sales. By 1995, however, RISC chips of all kinds will account for 25% of the $4.2 billion market for the 32-bit marketplace, with 75% remaining in the hands of CISC vendors, says ICE. It is thus a seminal time for all chip makers—including Intel—as those with a RISC offering work and wait for the day when some of those volume sales cross the chasm between the Unix-workstation world and the DOS-PC world.

"Intel believes it can still establish a proprietary RISC standard," Ross says. "It will probably take them three years to learn better. Intel missed a magnificent opportunity to incorporate RISC on the 486, to turn it into a 'swing machine' that could keep their old base hooked while swinging into a new base."

But proprietary systems eventually run into problems. "Being proprietary shields you from the forces of the market," explains Ross. In quasi-monopolistic markets, he says, companies that cease developing new products soon atrophy. "They just rake it in with old cash cows and eventually founder when a company such as Sun aggressively brings out new products every 18 months." As a result, explains Ross, Intel could develop the problems that kept Motorola from being successful with its RISC introduction—a fierce internal war between the "cash cow people and the new-technology guys. Motorola became schizophrenic fighting enemies within."

The storm that is brewing on the horizon may be spattering only a few raindrops on Intel's parade today, but could indeed bring serious margin pressure and competition to the microprocessor giant. The world of the desktop computer, where PC and workstation differences have merged into a sequence of upward-compatible products based on a variety of microprocessors, is now more than a pipe dream. ☐

Building a PC/workstation software bridge

Despite a show of unity, each of the major software players in ACE has its own plan for the desktop market

By Dwight Davis and Rick Whiting

Look at the photos from April's unveiling of the Advanced Computing Environment (ACE) consortium and you see smiling executives, hands clasped in solidarity as they vow to create an open, industry-standard operating environment for desktop computers. But behind the photos are plots, hidden agendas, and alliances worthy of a Shakespearean play.

Holding center stage in the ACE drama is Microsoft Corp., the $1.5-billion software company that is developing OS/2 version 3.0 for PCs and workstations conforming to ACE specifications. Microsoft also holds a key equity stake in ACE player The Santa Cruz Operation Inc. (SCO) and is enmeshed in a critical software development alliance with Digital Equipment Corp.

Chairman Bill Gates hopes to maintain Microsoft's domination of the desktop through ACE

Microsoft at a glance

Sales (millions)	$1,183
Profits (millions)	$279
Cost of goods/sales	21.4%
R&D/sales	15.3%
Capital expenditures/sales	13.4%
Employees	5,635

All figures for fiscal year ended Jun. 30, 1990

Source: Company reports

All this, when added to its control of the ubiquitous DOS and Windows operating environment, gives Microsoft an unprecedented level of influence within the desktop computer industry. "If power is measured by the ability to set others' agendas, then Microsoft, despite its still relatively modest size, is now the most powerful company in the computer industry," wrote analyst Marc Schulman of UBS Securities Inc.

But Bill Gates and his management team peer into the future of the slowing PC market, they see a growth rate far below what the Redmond, Wash.-based company has become accustomed to. Microsoft is hoping that ACE will ignite demand for a more powerful system and application software.

Microsoft is gambling that ACE will spur sales of OS/2, the PC operating system that was the intended successor to DOS. But because of its complexity and expensive hardware requirements, market acceptance of OS/2 has been slow.

Microsoft's moves, however, put it on a very different path from that of IBM, straining the already rocky partnership that created the PC industry over a decade ago. IBM, which jointly developed the original version of OS/2 with Microsoft, is not an ACE participant and plans on debuting the next release of OS/2—version 2.0—later this year.

MICROSOFT AND IBM profess support of each other's OS/2 development efforts but still sound wary. "We still meet periodically with IBM to review the OS/2 specs and IBM maintains an OS/2 team in Redmond," says Carl Stork, Microsoft's advanced development business manager. "It's in both our interests to continue to work synergistically."

"If [Microsoft's] OS/2 3.0 is really OS/2, then it will meet our requirements," says an IBM spokeswoman, noting that IBM will closely monitor Microsoft's work. "If it doesn't meet our requirements, then it's not OS/2." Even more skeptical are such industry executives as J. Paul Grayson, chairman and chief executive of Micrografx Inc., Richardson, Tex. Micrografx is working with IBM to integrate Windows technology into OS/2 2.0. "IBM is not happy with the way Microsoft has positioned OS/2 3.0," Grayson says. "I think there will be a divergence within the OS/2 market."

SCO, the other major software vendor in ACE, markets versions of Unix for Intel-based computers. But the Santa Cruz, Calif., company's strength has always been in selling multiuser operating systems while having limited success marketing Unix for single-user desktop computers, says analyst John Logan of

The Santa Cruz Operation

Ownership	Privately held; Microsoft has 20% equity
Headquarters	Santa Cruz, Calif.
Founders	Father and son, Larry and Doug Michels
Employees	1,300
1990 sales (millions)	$107

Source: The Santa Cruz Operation

the Boston-based Aberdeen Group Inc. SCO hopes to change that by having its Unix-based Open Desktop operating environment run on both ACE-compliant PCs and workstations based on RISC microprocessors from Mips Computer Systems Inc. in Sunnyvale, Calif.

Despite the fact that Microsoft and SCO are both ACE members, and the fact that Microsoft owns a 20% equity stake in SCO, observers believe the two may be setting themselves up for a fight for control of the desktop.

Microsoft is betting that the stranglehold DOS has on the desktop will continue with Windows and OS/2. SCO has staked its business on the hope that Unix will become a mainstream desktop operating system. Certainly SCO has an uphill battle: While Open Desktop brings some 4,000 third-party applications to the table, Microsoft's OS/2 version 3.0 will support the more than 35,000 software programs already written for DOS, Windows, and OS/2.

The wildcard in the ACE software scenario may be DEC. Software development alliances with Microsoft and SCO may provide substance to president Ken Olsen's oft-repeated claim that the Maynard, Mass.-based minicomputer maker is really a software company, not a hardware company.

SCO's president Larry Michels hopes that ACE will make Unix a mainstream desktop product

DEC is working with Microsoft to adapt OS/2 to the Mips microprocessor architecture, a natural follow-on to DEC's experience with porting Ultrix (its own Unix implementation) to the Mips chip. But analyst Schulman believes that the collaboration goes much deeper and that there is evidence of "a massive technology transfer" between the two.

IN A REPORT, Schulman writes that DEC may be providing some of its significant expertise in multivendor networking to Microsoft and speculates that, in return, Microsoft will port OS/2 3.0 to a line of RISC-based VAX computers DEC is currently developing.

DEC is also aiding SCO's efforts to develop Open Desktop for ACE. Open Desktop will be based on the kernel of OSF/1, the Unix-based operating system being developed by the Open Software Foundation. DEC, in fact, has canceled its own OSF/1 development efforts, turned its work over to SCO, and plans to license the final product from SCO as a replacement for Ultrix.

The results? Open Desktop will support the 2,000 applications already written for DEC's Ultrix for RISC workstations, allowing those programs to run on ACE-compliant RISC computers. Because OS/2 3.0 will be a migration path for IBM's OS/2 2.0, VAX computers running OS/2 3.0 would provide DEC with a tool for wooing IBM customers. And DEC may at last shake the industry perception that it is "anti-Unix."

The irony of ACE is that the major benefactor of its software efforts may be a hardware company. ☐

A "unified" environment is anything but

Despite the perception that ACE will create a unified operating environment for desktop systems, the consortium, in fact, is creating four distinct environments encompassing two operating systems and two microprocessor architectures.

Microsoft Corp. is developing OS/2 version 3.0 for both the Intel Corp. 80x86 microprocessor line and Mips Computer Systems Inc. RISC microprocessors. Although OS/2 for Intel and OS/2 for Mips will be compatible at the source-code level, applications written for one microprocessor architecture will have to be recompiled in order to run on the other. The same will be true of the Intel-based version of Open Desktop, The Santa Cruz Operation Inc.'s implementation of Unix, and the version of Open Desktop SCO is developing for Mips microprocessor-based workstations.

The two ACE operating systems, however, are incompatible and even make use of different graphical user interfaces: Open Desktop uses the Motif interface from the Open Software Foundation (OSF) while OS/2 version 3.0 will use Microsoft's Windows interface.

Both ACE operating environments will include a high level of network interoperability through their support of the distributed computing environment specifications developed by OSF, the consortium dominated by IBM, Digital Equipment Corp., and Hewlett-Packard Co. Microsoft's OS/2 version 3.0 and Open Desktop are slated to support the Posix programmers' interface standard.

Software developer kits for each operating system are slated for availability later this year with general availability of the operating systems scheduled for 1992. ☐

Will Europe's protectionists yield to the free marketers?

With old solutions no longer working,
the EC looks for new ways to get electronics back on its feet

by Barbara N. Berkman

As the 1992 deadline for European economic integration approaches, the European Community's bureaucracy and its electronics industry are at odds.

Everyone agrees that the EC's share of the world electronics market is slipping. But attempts to inject new life into its electronics industry are hampered by a long-standing disagreement on three fundamental issues: state aid, industrial and social policy, and free-market principles.

The basic problem is that the electronics industry, national governments, and the Brussels-based European Commission don't share common goals. "There are conflicting views as to what [a united] Europe represents," explains George Hall, head of government relations at Britain's International Computers Ltd. While Europeans are generally committed to the concepts of 1992, he says, individual EC governments still hold wildly diverse views on the role of state aid in a free market.

Despite aid from the European Community ...

EC funding programs for electronics ($ millions)*

Jessi (semiconductors)	
1989-1997	$4,000
Esprit (computers)	
Second round, 1987-1991	1,600
Third round, 1990-1994	1,352
European Nervous System (electronic networks)	
1991	380
Race (telecommunications)	
Second round, 1987-1991	550
Third round, 1990-1994	489
HDTV	
1986-1992	600
Total:	$8,971

*1 ECU per dollar

Source: EC Commission

In an effort to end the dispute once and for all, the Commission will lay the foundation of a pan-European electronics policy this month by issuing the first in a series of guidelines affecting European semiconductors, computers, telecommunications, and electronics research. Non-European companies will be watching closely for signs that all 12 EC member nations are beginning to abandon their protectionist policies in favor of improved product development cycles, more applied research, and better production methods. If so, non-European companies are expected to play leading roles in nursing European electronics back to health.

... the big five see income eroding

Company	1990 revenue ($ millions)	1990 net income ($ millions)
Olivetti	$771	$47
Philips	29,349	-2,210
Thomson	12,750	-414
Siemens Nixdorf	2,978	-227
Bull	5,970	-1,200

Source: Company reports

EUROPE'S ELECTRONICS market is complicated by several factors. For one, demand for computers and consumer electronics is depressed by high prices; computers and workstations in Europe are priced 40% to 50% higher than in the United States. Europe also lacks a big, deregulated market and a local, low-cost, U.S.-style components industry. Further plaguing the industry is Fujitsu's virtual takeover of ICL early this year; heavy 1990 losses by N.V. Philips, Groupe Bull, Siemens Nixdorf Informationssysteme, and Thomson S.A.; the floundering of Jessi (the Joint European Submicron Silicon Initiative, Europe's semiconductor consortium), and recent technical disputes that threaten European HDTV.

In the past, many European governments—especially in Italy and France—have propped up their industries with various forms of direct financial aid to ailing companies. It is no secret that the French government is determined that national companies such as Groupe Bull and Thomson survive even if they would be doomed in a free market.

Those anticompetitive policies no longer fly with the EC, which believes that European industry must

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"The next investments [in European electronics] will be from the U.S. and Japan," says ICL chairman Peter Bonfield

stand on its own or suffer the consequences. Policy makers increasingly suspect that their deep national divisions on state aid undermine any pan-European electronics policy. "What has been done in the past hasn't worked," says Roberto Schisano, president of Texas Instruments Europe. The debate now, he adds, is shifting to the real issues, such as global competitiveness, time to market, and the cost of capital differential between Europe, Japan, and the United States.

To put teeth into those issues, the Commission is moving to harmonize national industrial policies with a stronger pan-European competition policy, headed by Commissioner Leon Brittan. Brittan's best chance to thwart interventionism by individual EC governments may be to restrict the use of state aid.

European industry has already had a taste of that medicine from the free marketers. Recently the EC chastised the Italian government for extending aid to electronics companies one year longer than sanctioned by Brussels; the Commission made auto maker Renault repay $1 billion in aid from the French government that was ruled illegal; France's $1.5 billion aid package to Groupe Bull set off an inquiry into anticompetition violations; and, in a landmark decision in April, the European Court of Justice ruled that the Commission can force member states to break up monopolies (particularly in telecommunications equipment) that block a unified market.

There have been other signs of change. The EC is putting more money into marketing studies and feasibility assessments to bring companies closer to market demands, notes Ellen Hipschman, executive consultant for KPMG Regis McKenna in London. In April, the chief executives of Europe's five largest electronics companies met with EC officials to discuss a blueprint for saving European components and computers. The CEOs' recommendations will likely include the need for cheap capital, improved manufacturing and product development processes, and cooperation—even with non-Europeans—between components makers and users.

Another approach is to re-energize Europe's electronics companies by stimulating demand. Last March, Brussels issued an electronics policy paper that urged Europeans to wean themselves from state aid and promised help by boosting demand for electronics goods.

One idea backed by Commissioner Filippo Maria Pandolfi is a proposed computer infrastructure project that would award massive contracts for computers, peripherals, and software that link EC countries. While this so-called European Nervous System could raise demand for computers, some critics call the exercise a pork-barrel approach that makes about as much sense as damming the English Channel in order to create construction jobs.

Pandolfi also mulled over a proposal by SGS-Thomson chairman Pasquale Pistorio to merge the semiconductor operations of SGS-Thomson, Siemens, and Philips. "It is better to have one European company than splinters," says Pandolfi. While that notion draws attention to Europe's biggest problem—lack of scale—such a merger is unlikely.

Also unlikely (at least for now) is Pandolfi's idea of a European consortium, similar to Airbus, for chips and computers. European companies, like their U.S. counterparts, do not thrive in such arrangements; the Commission concedes that Jessi has thus far been anything but a re-

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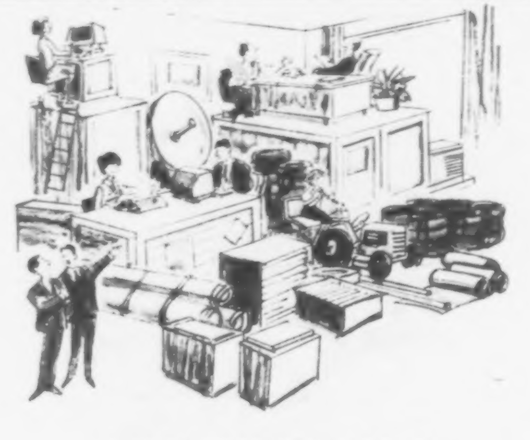

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sounding success. And current EC rules bar companies from entering cartel-like agreements that could restrict competition. That could change, however, if the Commission loosens its rules on cooperation.

FEW SOURCES WILL speculate on what all of this could mean to U.S. and other non-European electronics companies. But some, including TI's Schisano, see the move away from protectionism as a sign that cooperation with non-Europeans will be increasingly welcomed. As interventionist policies are slowly abandoned, European governments will be forced to open their traditionally closed public-procurement bidding processes to outsiders. The EC is determined to make the Jessi consortium more applications-driven, a process in which U.S. and Japanese semiconductor and systems companies are more experienced. "The next investments [in European electronics] will be from the United States and Japan," predicts ICL chairman Peter Bonfield. "Bull can't make mainframes without [technology from Japanese partner] NEC Corp., and we didn't make many good mainframes without Fujitsu."

That doesn't mean that European state aid is about to disappear entirely or that Europeans are happy to see their taxes supporting non-European competitors. Two years ago, for example, SGS-Thomson raised an international ruckus when the Italian government gave Texas Instruments $700 million to develop a DRAM fab in the depressed Mezzogiorno region.

It does mean that Europeans increasingly—reluctantly, perhaps—see international technology and marketing alliances as a key to the future of their electronics industry. The trick will be to structure those alliances so that a fair share of the payoffs will stay in European hands. "We don't want a 'Fortress Europe,'" says Pistorio. "But we don't want to sit down at the table with our partners and have nothing to eat." ☐

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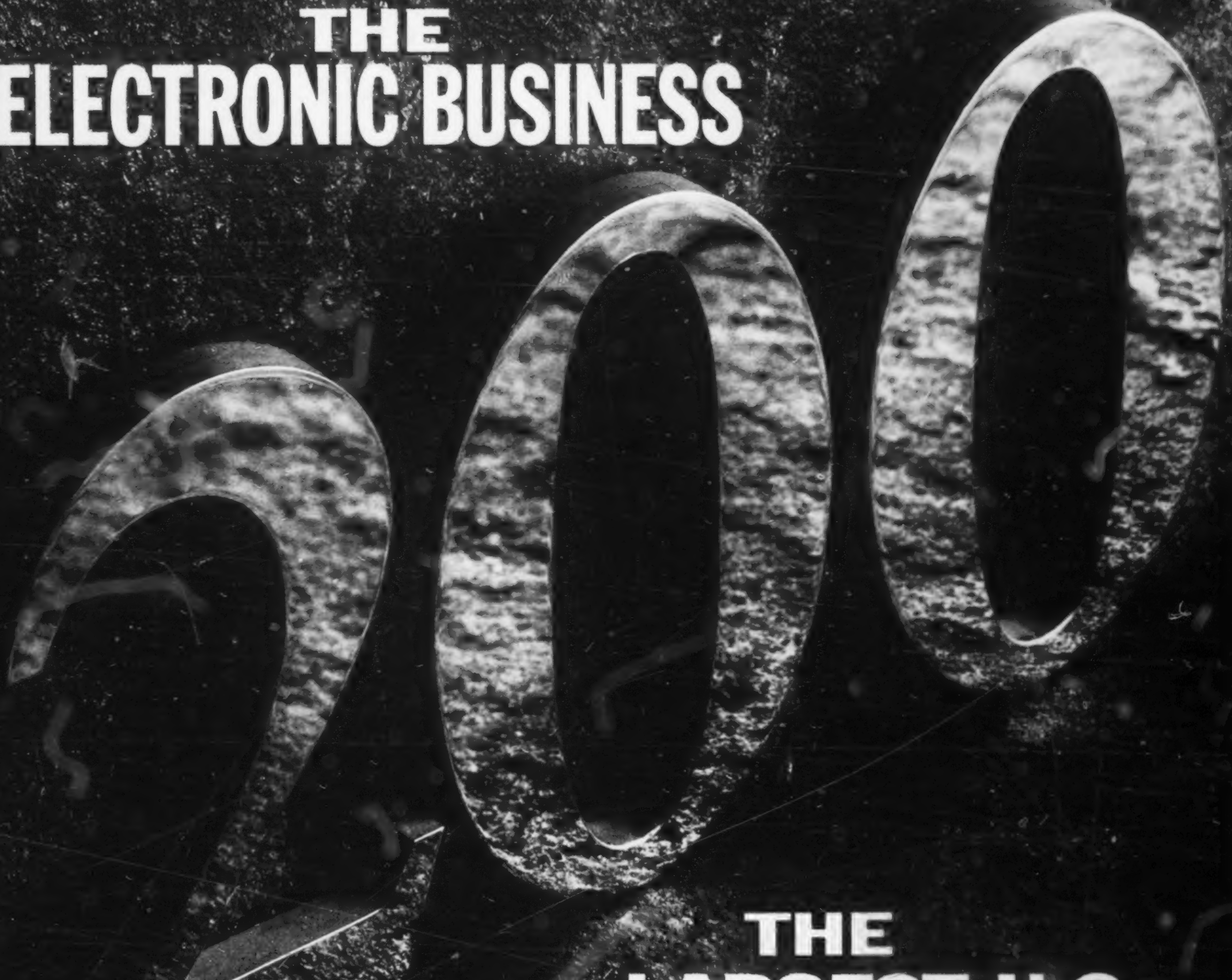

THE LARGEST U.S. ELECTRONICS COMPANIES

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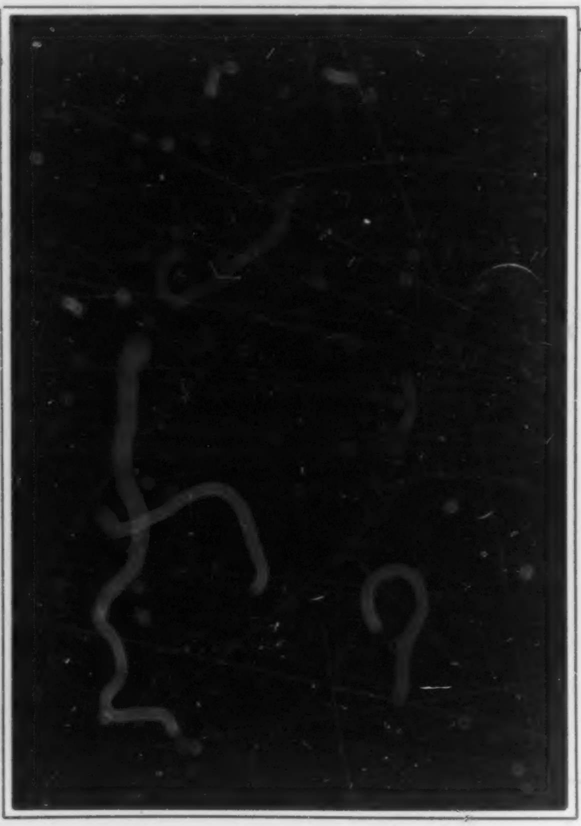

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Despite the recession, this year's economic analysis of the 200 largest U.S. electronics companies offers good news for productivity and margins. The bad news is that profits growth for these companies deteriorated for the third year in a row, suggesting that the industry's efforts to restructure and downsize have yet to show up on the bottom line

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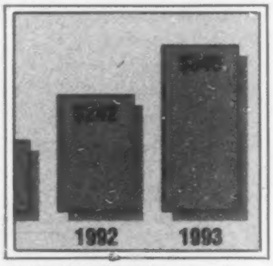

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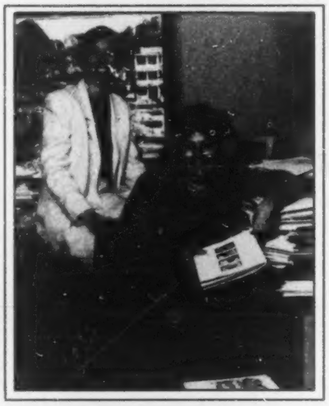
INSIDE BUSINESS

The top 200 issue: all in a year's work


Senior editors Baatz and Stallmann unearth the top 200 from hundreds of annual reports

TWO hundred may seem a modest number, but it's far from modest when the 200 in question are the top 200 U.S. electronics companies. Nor is it a cakewalk for senior editors Linda Stallmann and Elizabeth Baatz to scrutinize each of those companies' annual performance for the good, bad, ugly, and just plain interesting results that reveal industry trends.

Consider, first, that the annual ELECTRONIC BUSINESS 200 report actually starts with the ELECTRONIC BUSINESS "400." Refining and updating the listings is actually a year-round chore. Every spring, letters go out to 400 companies requesting annual reports, quarterly reports, 10-K forms, and proxy statements. Linda and her helpers don't take no for an answer: They make an estimated 225 follow-up phone calls to slow-to-respond companies. And in the course of a year, Linda reads 7,000 to 8,000 pages of annual reports. (We don't recommend that you try this at home.)

In-depth research differentiates the ELECTRONIC BUSINESS 200 from the lists of top companies you'll find in some magazines that pull financial data from professional listing services. Is it all worth it? We think so, and the popularity of previous "top 200" issues tells us that you agree. This year's issue—a tale of pain and progress—should prove no exception.

The "pain," once again, refers to profitability—or rather, the lack thereof. Overall profit growth fell again for the third year in a row, and return on stockholders' equity fell a full percentage point from the previous year. The progress showed up in improved productivity and better margins.

A vital part of this report is the collection of charts and tables that rank companies by sales, profits, and best and worst performance. Many of the rankings will surprise you.

As a service to readers, current and prior versions of the ELECTRONIC BUSINESS 200 are available on disk—both IBM compatible Lotus 1-2-3 and Apple Macintosh Excel versions. The cost for any single year is $100, or $200 for any three years. To order, please phone Jean O'Brien at (617) 558-4257.

—John Parker, contributing editor

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BPA ABP

essing system that gives supercomputer performance at under $100 per Mflops (million floating-point operations per second).

—Barbara N. Berkman in London

AUTOMATION

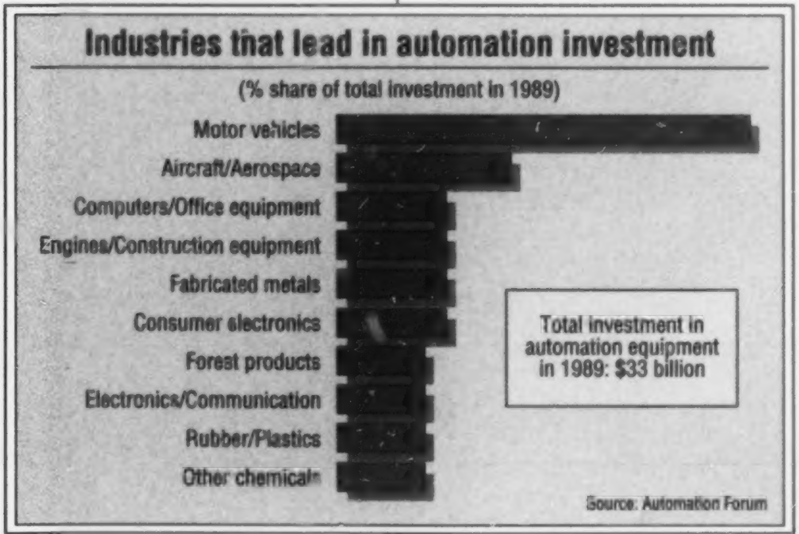
Tallying up a new industry

ONE OF THE PROBLEMS perpetually facing U.S. industry numbers-crunchers has been to define and measure everything from semiconductor sales to the trade deficit to how much and how well industry is investing in new technologies. Now the Automation Forum in Washington, D.C., a network of industry executives from nine U.S. trade associations, has published a study that attempts to define the automation marketplace and to put some hard figures on U.S. industries' spending.

According to the Automation Forum, U.S. industries spent $32.98 billion on automation investments in 1989. In fact, according to published data from the Commerce Department, investment spending on information processing equipment alone now accounts for 32 cents of every dollar spent on equipment by U.S. companies, up from 26 cents in 1980. This trend, which is likely to continue, points to the fact that investment spending plans clearly have and will continue to have a significant impact on the electronics industry's future.

Which industries are spending the most on automation? The top automation purchaser was the motor vehicles industry, which spent over $6 billion in 1989 to take 19% of the total U.S. automation spending. Aircraft and aerospace accounted for 8% of automation investment. High-tech industries (perhaps because they are newer and already automated) account for somewhat lower sales. The computer and office equipment industries accounted for just 5% of total automation spending in 1989. Electronics and communications took a 4% share.

—Elizabeth B. Baatz


Industries that lead in automation investment

(% share of total investment in 1989)

Source: Automation Forum

SEMICONDUCTOR EQUIPMENT

Denser chips mean bigger bucks

ALTHOUGH A recession-cautious industry left the semiconductor equipment industry cooling its heels, a push toward higher density memory chips has finally started some cash registers ringing up a happier tune.

Semiconductor makers must ante up for newer generation equipment if they hope to compete in the emerging 16-megabit DRAM market. On the horizon is the need for equipment that can produce 64-Mbit DRAMs. New fabs are under construction around the world and must be filled with equipment that can process the bigger 8-inch wafers.

One example, Etec Systems Inc., in Hayward, Calif., reports sales are up 44% during the first half of 1990 over the same time last year, moving the company from losses to profitability and a $50 million order backlog.

Yet while the equipment industry is feeling some optimism, an abrupt turn in the road ahead could create a few navigational hazards. Customers are starting to push for open systems in production equipment called MESC (Modular Equipment Standards Committee).

That standard, which allows customers to mix and match equipment from various vendors, is beginning to take shape as companies such as Novellus Systems, Lam Research, and Materials Research offer MESC-compatible products.

—Teri Sprackland in San Jose

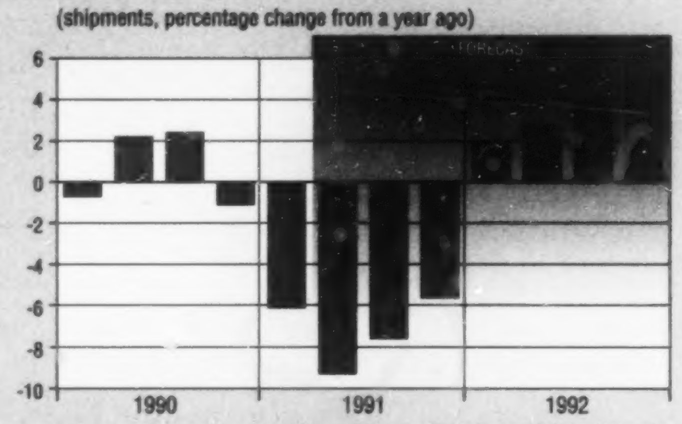
MICROPROCESSORS

Ford Motor Co. and Motorola: goin' mobile

WITH ALL THE focus on the battle for the desktop reduced instructions set computing (RISC) market, and Motorola's lack of presence in same, the company's orphaned 88000 microprocessor found a friend in the most unlikely of places when Ford Motor Co. picked a version of the chip as its next Powertrain Electronics Controller.

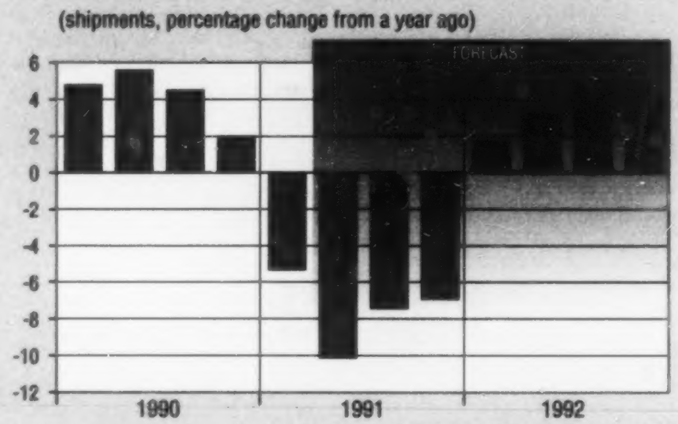
Though the win won't generate any real sales for Motorola until the mid-1990s, the sheer volume of embedded controller sales—analysts estimate Ford's potential consumption at more than 6 million units per year—will boost the acceptance of architecture and allow the company

Military electronics market weakens in '91...



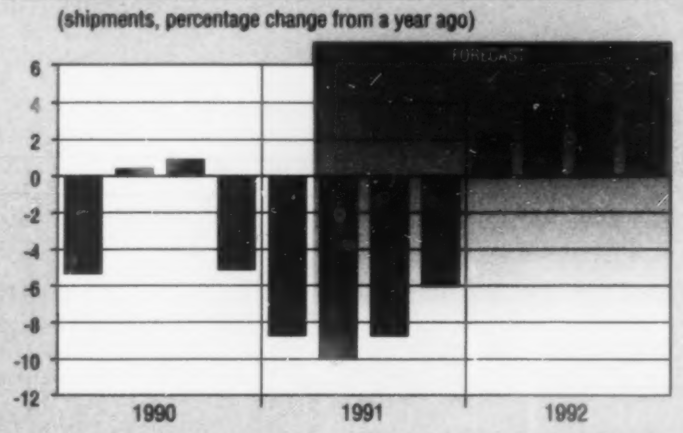
Source: Commerce Dept.; forecast: Cahners Economics

...before defense aircraft lifts off in '92...



Source: Commerce Dept.; forecast: Cahners Economics

...and search & navigation equipment follows suit



Source: Commerce Dept.; forecast: Cahners Economics

Military electronics retreats to 1980 levels

PRODUCERS OF military electronics will have to bite the bullet in 1991 before sales stabilize in 1992. Recessions did not cut into government contract work in the past decade, but that is no longer true. The huge national debt has tied the hands of government officials so that federal spending will have no role in stimulating an economic expansion.

New orders for military electronics have already sounded the warning bell by plummeting 15.7% in 1990. The $50.2 billion worth of orders last year was the lowest dollar value of orders recorded since 1983. Shipments rose a mere 0.7% in 1990 to post a record $58 billion but, because of lower demand, will retreat 7.2% to $53.8 billion this year. The outlook for 1992 provides a slight recovery of 3.5% growth in shipments, to $55.7 billion. Taking inflation into account, however, this means sales will only stabilize.

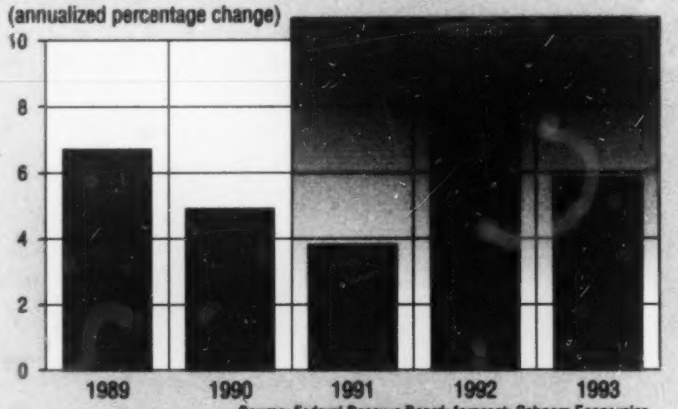
Despite being showcased in the Gulf war, the military aircraft, missiles, and parts market will fall 7.4% from $60.6 billion to $56.1 billion in 1991. According to the Aerospace Industries Association, sales of military aircraft alone are expected to fall 16.2% to $32.1 billion. When adjusted for inflation, this will be the lowest sales figure recorded since 1982.

Lofty cutbacks will also hit shipments of defense search and navigation equipment in 1991. Sales are forecast to decline 6% before a recovery of 4.9% is realized when new programs begin to take hold in 1992. Even after slight growth next year, military spending will remain a far cry from the peak spending levels that the market enjoyed in the mid-1980s.

—John Farrell

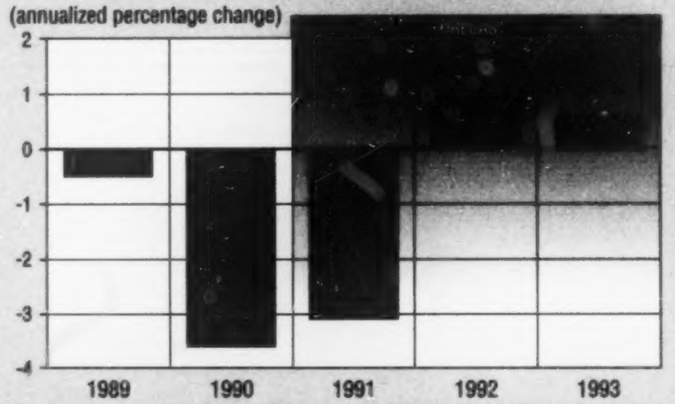
For more information on Cahners Economics' forecasts, contact Dan Buchan at (617) 630-2105 or by fax at (617) 630-2100.

As electronics production turns up...



Source: Federal Reserve Board; forecast: Cahners Economics

...employment will recover slowly too



Source: Bureau of Labor Statistics; forecast: Cahners Economics

A look at the employment forecast

	Number employed	annual % change		
	Dec. 1990	1991	1992	1993
Total	2,178,700	-3.1%	1.0%	0.6%
Instruments	840,800	-2.9	0.9	0.2
Components	568,700	-1.5	3.3	2.3
Computers & office equipment	432,400	-4.9	-1.8	-0.3
Communications	255,700	-4.3	-0.1	-0.5
Consumer	81,100	-3.0	3.1	0.8

Markets are categorized by *1987 Standard Industrial Classifications*; as a result, military electronics are included with instruments

Source: Bureau of Labor Statistics; forecast: Cahners Economics

Electronics employment to brighten (a bit) in '92

OUCH! EMPLOYMENT in the once-hardy electronics industry has certainly taken it on the chin. During the last recession in 1986, electronics employment fell 3.8%—the first time layoffs outraced new hires in the industry since 1975. With the cost-cutting and restructuring craze of the late 1980s, employment levels never fully recovered. Annual employment growth has risen only once in the four years since 1986, and then by only 0.9% in 1988. During the past year, the number of workers employed by the U.S. electronics manufacturing industry fell again by 3.1%, to 2.2 million.

Which electronics markets have been hardest hit by the latest cuts? Employment in the semiconductor and components sector tumbled 5.2% in 1990—on a par with the employment decline seen in the 1986 recession. The number of layoffs and early retirements in the computer and office equipment industry increased as well, as employment fell 4.3% in 1990. As of this past April, employment in this critical industry stood at only 424,000 workers—nearly the same as in 1980.

Now the electronics industry is preparing for the next upturn. Will employment grow again?

Yes, but slowly. The number of workers employed next year will remain below 1984 to 1985 employment levels. Cahners Economics' outlook calls for total electronics employment to have passed a low point in the second quarter of this year and slowly inch up thereafter. By the end of 1992, Cahners expects a meager—albeit encouraging—1% gain in employment. So, the exodus of employees in the industry will be coming to a halt, even though rehiring will see a slow and tedious recovery.

—Julie Handelman

INTRODUCTION

[illegible] U.S. [illegible] panies turned in mixed performances in 19[illegible]. Productivity and [illegible] [illegible] improved last year [illegible] the recessionary [illegible] fell for the third year [illegible] equity, the stockhol[illegible] profitability, dropped [illegible] 1990. Return on investment, the return on equity plus debt, fell to 6.[illegible], even lower [illegible] the recession [illegible] set [illegible]. These are some [illegible] results from [illegible] analysis [illegible] 200 [illegible] U.S. [illegible] publicly held [illegible] computer, and [illegible] companies. In this [illegible] edition of the ELECTRONIC BUSINESS 200, companies are ranked by electronics sales for calendar year 19[illegible]. The [illegible] is derived from [illegible] K and [illegible] interviews with company executives, and [illegible] estimates.

This year ELECTRONIC BUSINESS also takes a close-up look at productivity, profitability, and debt, and pro[illegible] the companies that [illegible] the farthest in the ranks of [illegible] since last year's report. [illegible] behind the numbers, these stories tell much about the electronics industry's recent triumphs and future threats. ☐

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THE ELECTRONIC BUSINESS

THE LARGEST U.S. ELECTRONICS COMPANIES

THE ELECTRONIC BUSINESS
200

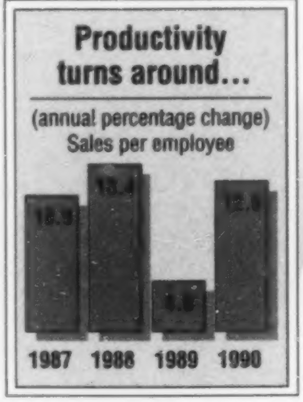
By Linda Stallmann and Elizabeth B. Baatz

PROFITS take another PLUNGE

Productivity and margins rose nicely last year, but falling return on equity still plagues the industry

Restructuring. Customer satisfaction. Total quality. These buzzwords, sprinkled liberally throughout last year's crop of electronics company annual reports, all point toward fundamental changes in the way that U.S. electronics and computer companies are run.

As of last summer, those changes had not yet produced a payoff on the bottom line. But this year's economic analysis of the largest 200 U.S.-based electronics companies shows that early positive signs in both productivity and margins have emerged—in spite of a recession that finally erupted last year.



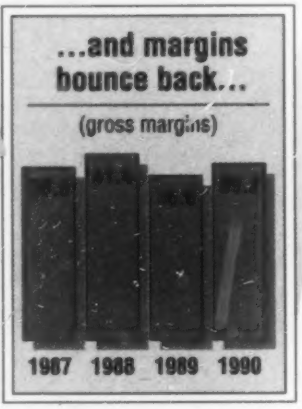
Productivity turns around...

(annual percentage change) Sales per employee

Productivity for the ELECTRONIC BUSINESS 200, as measured by sales per employee, rose 12% in fiscal 1990—up strongly from the prior year's subpar 4% gain. Gross manufacturing margins, after stumbling to 36.6% in fiscal 1989, bounced back last year to 39.2%. (Margins defined by ELECTRONIC BUSINESS include manufacturing costs of products, services, and rentals minus depreciation only.)

These results are a far cry from the previous year's doom and gloom. When ELECTRONIC BUSINESS analyzed the 200 financial statements of 1989, falling profits coupled with painfully slow productivity gains and falling margins painted a very bleak picture. This year's report at least shows some glimmers of hope.

Unfortunately, all the restructuring, downsizing, and attention to total quality have yet to show up on the bottom line. Profits growth for the top 200 electronics companies deteriorated for the third year in a row, and for the fifth time in the past seven years.



...and margins bounce back...

(gross margins)

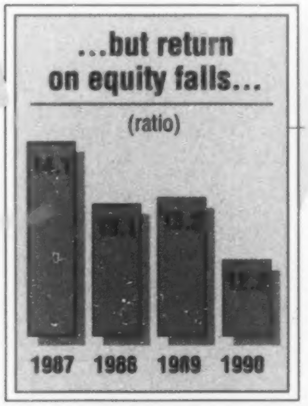
Even worse from the investor's point of view, return on equity averaged just 12.2% for the 200 in fiscal 1990 (meaning that a company earned 12 cents in profit for every stockholder's dollar invested). That's down a full percentage point from the previous year and a far cry from the 16.5% average return on equity during the industry's heyday in 1984.

A falling return-on-equity ratio is particularly disturbing because corporate debt for the 200 rose again to a record-breaking level last year. When debt rises, there is usually less likelihood that equity will rise to meet a firm's financing needs. Yet these aggregate debt figures, which include debt from firms such as E. I. DeNemours DuPont and Co. and Chrysler Corp., may not be as threatening as they first appear. The average debt burden among companies that sell mostly electronics products stands at a relatively comfortable 31.1%. Nonetheless, too much debt at large companies like Xerox and Unisys means big interest costs, which can hamper a company's future.

The upshot is that U.S. electronics companies are finding it harder than ever to make a buck. Last year's improved productivity and margins should have led to increased profits, but didn't. However, if productivity and margins continue to rise this year and next, rising profits won't be far behind.

THE TOP RANKS of the ELECTRONIC BUSINESS 200 have changed little over time. IBM and AT&T have maintained their #1 and #2 positions, respectively, since the first analysis of the ELECTRONIC BUSINESS 100 in 1978 (when AT&T's electronics division was known as Western Electric).

Last year, though, three electronics companies moved up one position each on the top 10: Xerox to #3, Hewlett-Packard to #4, and Motorola to #7. Making room for these climbers were Digital Equipment, which fell two positions to #5, and Unisys, which dropped one notch to #8. The top 10 companies accounted for 48% of the ELECTRONIC BUSINESS 200's electronics revenue and 39% of net income last year.


...but return on equity falls...

(ratio)

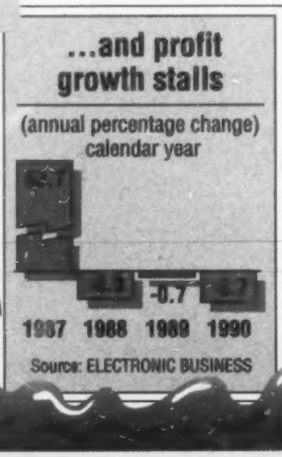
In fact, the top 10 ranks have long been an exclusive club. Eight of today's top 10 companies were so honored in 1984. Only two—GM Hughes Electronics and Unisys—have managed to break into the club, thanks to the disappearance of ITT (now #28) and Honeywell (still nipping at Texas Instruments' heels in position #11). The billion-dollar club has been a bit more hospitable: Today 63 companies generate over $1 billion in electronics revenue, 10 more companies than in 1984.

BUT SHEER COMPANY SIZE is not the primary goal of any CEO—performance is. And, as usual, size alone did not guarantee performance. Three companies in the top 10—Unisys, Digital Equipment, and Texas Instruments—collectively lost over $570 million last year. In fact, 38 companies lost money in calendar 1990 (up from 36 the year before and only 26 in 1987), and seven companies lost over $100 million each last year.

General Dynamics Corp. takes the dubious honor of biggest money-loser, with a net loss of $639 million in calendar 1990. The termination of the A-12 aircraft program and restructuring charges, as the company adapts to a shrinking military market, accounted for much of the loss. Restructuring also hit hard at Wang Laboratories and Unisys, where losses hit $584 million and $437 million, respectively.

While General Dynamics lost the most money, another military contractor—Lockheed Corp.—won the top spot for the largest percentage increase in profits from calendar 1989 to 1990; its profits rose from $6 million to $335 million. This year-to-year comparison is suspect, however, because Lockheed had significant write-offs involving fixed-price development programs in 1989.

The next three largest profit increases all came from the computer market. Dell Computer, AST Research, and Sun Microsystems all increased profits more than threefold last year. Dell Computer's


...and profit growth stalls

(annual percentage change) calendar year

Source: ELECTRONIC BUSINESS

THE ELECTRONIC BUSINESS
200

The biggest gainers

The ten largest increases in sales		200 rank
Conner Peripherals	89.8%	51
Borland International*	82.8	199
Northgate Computer*	82.3	192
Quantum	81.7	77
Maxtor	76.5	73
Pyramid Technology*	75.2	193
Archive	72.7	122
Thermo Electron*	71.2	160
Sequent Computer Systems*	70.9	163
Microsoft	55.1	47

The five largest increases in profits**		
Lockheed	5,483.3%	19
Dell Computer	432.5	87
AST Research	360.4	82
Sun Microsystems	317.7	30
Arrow Electronics	214.4	65

*New arrivals to the ELECTRONIC BUSINESS 200

**Excludes companies that lost money in calendar 1989

Calendar year

Source: ELECTRONIC BUSINESS

The biggest losers

The five largest decreases in sales		200 rank
Control Data	42.4%	44
Smith Corona	19.3	123
Recognition Equipment	15.5	189
Concurrent Computer	14.0	134
Micron Technology	13.8	120

The five largest decreases in profits*		
VLSI Technology	2,617.8%	124
Tektronix	2,557.4	49
Ultimate	1,862.0	197
Bally Manufacturing	1,232.3	146
Western Digital	635.7	60

The five largest losses ($ millions)		
General Dynamics	$639.0	59
Wang Laboratories	583.6	37
Unisys	436.7	8
Bally Manufacturing	292.3	146
National Semiconductor	169.6	43

*Decreases reflect swings from 1989 profits to 1990 losses

Calendar year

Source: ELECTRONIC BUSINESS

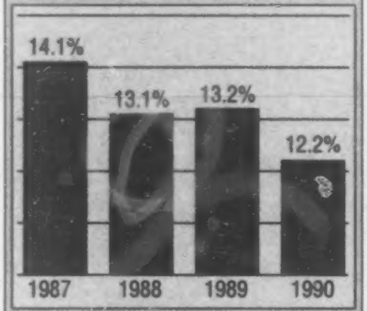
Composite performance of the ELECTRONIC BUSINESS 200

Calendar years	1985	1986	1987	1988	1989	1990
Electronics sales ($ billions)	$267.8	$279.2	$299.2	$327.7	$340.8	$362.3
Total sales ($ billions)	$797.8	$641.7	$689.7	$774.5	$814.9	$865.5
Net profits ($ billions)	$35.4	$26.7	$41.0	$39.7	$39.4	$38.0
Weighted average*	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**
Return on equity	11.8%	10.2%	14.1%	13.1%	13.2%	12.2%
Return on investment	8.7%	7.2%	10.1%	7.2%	6.7%	5.7%
Cost of goods sold/sales	70.3%	63.7%	61.5%	58.6%	63.4%	60.8%
R&D/sales	4.2%	5.0%	5.2%	5.1%	5.5%	5.2%
Sales per employee	$110,800	$102,348	$113,533	$128,756	$133,941	$150,010
Net profits per employee	$5,000	$4,266	$6,662	$6,646	$6,761	$6,675
5-year compounded annual growth rate:						
Sales	5.0%	8.2%	10.7%	11.5%	7.7%	9.1%
Net profit	1.4%	4.0%	13.9%	8.3%	3.3%	5.4%
Capital outlays to net cash flow after dividends	118.3%	97.9%	73.9%	83.8%	95.0%	98.9%
Debt to capital	26.7%	29.9%	28.2%	45.3%	49.1%	53.2%
Foreign sales/total sales	14.0%	25.4%	24.9%	31.5%	32.3%	33.6%

*Fiscal year

Source: ELECTRONIC BUSINESS

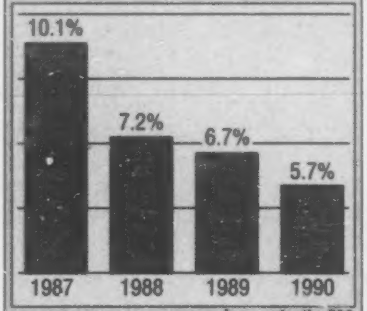
Return on equity



Average for the 200

The top five		200 rank
Smith Corona	50.0%	123
Reliance Electric	34.0	92
Apple Computer	32.8	13
Eli Lilly	32.5	89
Quantum	30.7	77
Median for the 200	11.3%	
The bottom five		
MAI Systems	-162.7%	116
Wang Laboratories	-151.5	37
Datapoint	-137.7	148
Bally Manufacturing	-87.9	146
Bolt Beranek & Newman	-80.6	150

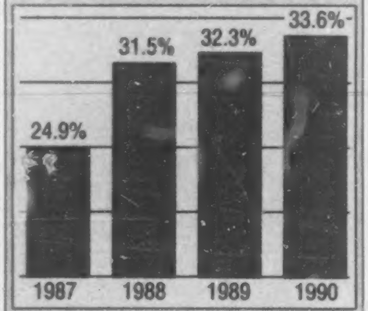
Return on investment



Average for the 200

The top five		200 rank
Quantum	30.7%	77
Apple Computer	30.3	13
Microsoft	30.2	47
Premier Industrial	29.0	108
Autodesk	26.0	171
Median for the 200	6.9%	
The bottom five		
Wang Laboratories	-60.7%	37
Datapoint	-58.8	148
Northgate Computer	-57.9	192
Data General	-26.6	56
Bolt Beranek & Newman	-26.5	150

Foreign/total sales



Average for the 200

The top five		200 rank
Tandon	95.8%	107
Datapoint	91.2	148
Atari	88.7	109
Molex	71.1	81
Micropolis	68.5	117
Median for the 200	36.1%	
The bottom five		
Penn Central	1.0%	93
Northgate Computer	3.0	192
Grumman	4.9	64
Zenith Electronics	6.1	48
Tandy	6.7	16

Fiscal year

Excludes companies with no foreign sales
Source: ELECTRONIC BUSINESS

profit growth, in particular, has not been a flash in the pan: Over the past five years, the company's profits, compounded annually, have grown 104%. Only three other companies—Intel, Seagate Technology, and Oracle Systems—managed to beat Dell in long-term profit gains.

Although profits have become tougher to generate in this maturing industry, many companies have excelled at growing revenue. One industry stands out from the others: disk drives. Three of the five companies that saw the largest percentage increase in sales from calendar 1989 to 1990 all make disk drives. Conner Peripherals, Quantum, and Maxtor each grew sales over 75% in 1990 from the prior year; only Maxtor failed to parlay that growth into a net income gain. Borland International and Northgate Computer, both newcomers to the 200, round out the list.

But the long-run sales growth prize goes to the computer market. When measuring sales growth compounded annually over the past five years, three computer companies outpaced everyone else—Encore Computer, Teradata (ELECTRONIC BUSINESS's fastest-growing company in 1990), and Sequent Computer Systems.

Which companies suffered the largest sales decline? Topping the list is high-speed-computer maker Control Data Corp., whose sales declined 42% to $1.7 billion in calendar 1990. As a result, Control Data fell from #24 on the list to #44. The company, in fact, has been struggling for some time and leads companies with the largest sales declines over the past five-year period.

Other companies that saw sharp sales declines from 1989 to 1990 include Smith Corona, Recognition Equipment, Concurrent Computer, and Micron Technology. In most cases, a decrease in sales led to red ink on the bottom line, although four companies of the top 10 in declining sales—Control Data, Smith Corona, Chrysler, and M/A-Com—managed to spin a profit last year.

Threatening trends seem to accompany every ELECTRONIC BUSINESS analysis. This year, the biggest worries may be the large number of companies with excessive debt and the inability of the industry to grow profits. But the long-term health and competitiveness of the U.S. electronics industry may also be under fire from other directions:

- A growing dependence on revenue growth from activities other than manufacturing;
- A slowdown in foreign revenue growth;
- Insufficient long-term investment in capital spending;
- Continued deterioration in the industry's average return on investment.

These problems are not new, but the trends show they are getting worse. With respect to revenue growth, for example, ELECTRONIC BUSINESS recently documented Texas Instruments' increasing dependence on royalty income rather than operating income ("How TI attacks the global market," May 6, 1991). IBM also is growing less from product sales and more from other revenue streams. In 1990, for example, IBM's total revenue grew 10.1%, but product sales rose only 5.7%. IBM managed to eke out double-digit growth last year due

Industry segments tell a mixed tale

A LOOK AT THE trends within the ELECTRONIC BUSINESS 200's industry segments can be revealing. In software, for example, the number of companies rose from 10 in 1989 to 13 in 1990 with the addition of Autodesk, Borland International, and Cadence Design Systems. Three companies—Convex Computer, Pyramid Technology, and Sequent Computer Systems—joined the mainframe computer segment, now 10 companies strong.

Nearly all industry segments enjoyed higher productivity. Sales per employee increased for every segment except distribution, peripherals, and software. But comparisons between 1989 and 1990 can sometimes be misleading. The addition of distributors Bell Industries Inc. and Premier Industrial Corp. to the 200, for example, brought the productivity average down for the entire distribution segment. Actually, all six original distribution companies on 1989's list saw significant improvement in productivity in fiscal 1990. Desktop computers showed the most dramatic rise in productivity, with sales rising from an average $168,200 per employee to $263,600, to gain the title of the most productive industry segment.

Other good news includes the fact that cost-cutting paid off in gross margins. Nine of the 16 segments reduced their cost of goods and improved margins. Traditionally high-cost segments such as distribution and peripherals lowered their costs from fiscal 1989 to 1990: Distribution fell from 75.7% to 72.3% and peripherals from 72.4% to 70.2%. The software industry, which has the lowest manufacturing costs of all segments, saw an already low 17.5% cost fall

Comparing industry segments

Productivity

Sales per employee ($ thousands)	1990	1989
Desktop computers	$263.6	$168.2
Distribution	255.9	273.9
Software	173.7	183.6
Mainframes	169.0	153.1
Diversified	157.5	140.5
Computer-based systems	141.1	116.2
Medical	133.0	117.8
Office equipment	131.0	117.9
Minicomputers	112.9	104.5
Communications	110.3	95.3
Consumer	108.9	101.3
Instruments	108.5	105.0
Government	107.5	100.3
Peripherals	104.4	138.0
Semiconductors	100.7	94.2
Components	86.9	84.3

Fiscal year

Cost of goods sold

(as % of sales)	1990	1989
Distribution	72.3%	75.7%
Government	71.7	70.7
Peripherals	70.2	72.4
Consumer	65.2	65.2
Components	62.5	61.4
Instruments	58.5	52.1
Semiconductors	57.6	58.0
Communications	55.3	54.8
Desktop computers	50.0	51.1
Computer-based systems	49.5	52.6
Minicomputers	44.7	42.9
Office equipment	42.6	42.3
Diversified	42.3	42.6
Mainframes	40.9	42.5
Medical	40.2	41.0
Software	15.8	17.5

Fiscal year

All figures are weighted averages. For list of companies in each segment, see detailed industry segment tables to a 14.8% increase in support services, an 18.1% jump in software, and a 33.2% surge in rentals and financing revenue. These nonmanufacturing revenue categories accounted for 36% of total revenue, up from 33% two years before. While IBM has protected itself by growing nonmanufacturing revenue, one wonders whether this reflects a blow to the competitive standing of U.S. manufacturing.

The recent slowdown in foreign sales by U.S.-based electronics companies poses a greater threat than ever, since U.S. companies rely on foreign revenue growth to offset slow domestic sales. Indeed, 38 companies on the 200 list received more than half of their sales dollars from foreign buyers; another 64 companies relied on foreign sales for more than a third of their revenue. A slowdown in international markets thus could have a profound effect on company performance.

At Digital Equipment, for example, sales to Europe grew 21.5% in fiscal 1989 but slowed to a meager 2.2% in 1990. Other foreign revenue slowed from 22.2% to a disappointing 6.4% over the same period. The result: Digital Equipment lost $94 million in calendar 1990 and dropped from #3 on the list to #5.

Struggling to adapt from a mammoth microcomputer company to a market-driven technology company, Digital Equipment may be a unique case. But the lesson is here to be learned: Foreign sales may not be the future salvation of U.S. electronics companies.

The tendency of U.S. companies to underinvest in new plants and equipment also has become more worrisome every year. Jerry Wasserman, vice president of consultants Arthur D. Little Inc. in Cambridge, Mass., has been sounding the warning for ELECTRONIC BUSINESS since 1987. The ratio of capital expenditures to net cash flow after dividends shows how a company uses internally generated funds to support capital spending. A ratio below 100 in the electronics industry generally indicates inadequate investment, says Wasserman. And the 200's capital-spending ratio has been below 100 for five years now.

Of course, the biggest critic of the U.S. high-tech companies continues to be Wall Street. And who can blame them? Return on investment for the 200 dropped to an average 5.7%, one percentage point below 1989 and the lowest return ever. While stars such as Quantum, Apple Computer, and Microsoft shine with returns on investment greater than 30%, the electronics industry must perform better overall if it hopes to regain investors' confidence.

On a more positive note, this year's ELECTRONIC BUSINESS 200 reveals the first signs of promise from restructuring and attention to quality. An increase in productivity and improved margins are exactly the statistics one would expect to see turn around first. The next step: improving profitability. ☐

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to 15.8%. The hard-hit minicomputer industry saw cost of sales rise from 42.9% in 1989 to 44.7% in 1990. Other industries that increased costs were government, components, instruments and measurement, communications, and office equipment.

Half of the industry segments enjoyed rising profitability and the other half suffered declines, with one segment actually registering a net loss. Software has always led, and still leads, the entire electronics industry in profits as a percent of sales, although profitability fell from 12.1% in calendar 1989 to 9.9% in 1990. But the gap narrowed as medical equipment makers improved their position to #2 by boosting profitability from 6.3% in 1989 to 8.6% in 1990. Thus, the software industry's advantage is rapidly disappearing as medical equipment and desktop computer makers improve their profitability. One of the biggest drops was again the minicomputer industry with profits as a percent of sales dropping from 3.7% in 1989 to -3.8% in 1990.

—Linda Stallmann

Profitability

(net profit/sales,%)	1990	1989
Software	9.9%	12.1%
Medical	8.6	6.3
Desktop computers	8.3	7.1
Diversified	7.5	5.2
Mainframes	6.9	3.7
Components	6.5	6.3
Computer-based systems	5.6	5.9
Office equipment	4.7	4.1
Communications	4.0	4.9
Distribution	3.9	2.4
Government	3.7	4.7
Semiconductors	3.3	4.8
Peripherals	3.3	1.3
Instruments	3.1	6.8
Consumer	2.5	4.3
Minicomputers	-3.8	3.7

Calendar year

Source: ELECTRONIC BUSINESS

THE ELECTRONIC BUSINESS
200

FINANCIAL TABLES 1-50

Rank			Calendar year 1990				Fiscal year 1990	
1990	1989	Company Location	Electronics sales ($ millions)	Total sales ($ millions)	Net profits ($ millions)	Profits % of sales	Return on assets	Return on equity
1	1	**IBM** Armonk, N.Y.	$69,018	$69,018.0	$6,020.0	8.7%	6.9%	14.1%
2	2	**AT&T** New York	16,832	37,285.0	2,735.0	7.3	6.2	19.4
3	4	**Xerox** Stamford, Conn.	13,583	13,583.0	599.0	4.4	1.9	9.8
4	5	**Hewlett-Packard** Palo Alto, Calif.	13,538	13,538.0	771.0	5.7	6.5	11.6
5	3	**Digital Equipment** Maynard, Mass.	13,072	13,072.3	-94.5	-0.7	0.6	0.9
6	6	**GM Hughes Electronics** Detroit	11,723	11,723.1	577.2	4.9	4.5	7.1
7	8	**Motorola** Schaumburg, Ill.	10,885	10,885.0	499.0	4.6	5.7	11.7
8	7	**Unisys** Blue Bell, Pa.	10,111	10,111.3	-436.7	-4.3	-4.2	-12.5
9	9	**General Electric** Fairfield, Conn.	9,430	58,414.0	4,303.0	7.4	2.8	19.8
10	10	**Texas Instruments** Dallas	6,567	6,567.0	-39.0	-0.6	-0.8	-1.7
11	11	**Honeywell** Minneapolis	6,309	6,309.1	371.8	5.9	7.8	21.9
12	12	**NCR** Dayton, Ohio	6,285	6,285.0	369.0	5.9	8.1	20.6
13	13	**Apple Computer** Cupertino, Calif.	5,741	5,740.6	500.6	8.7	16.0	32.8
14	14	**Raytheon** Lexington, Mass.	5,517	9,267.7	557.3	6.0	9.1	19.6
15	15	**Rockwell International** El Segundo, Calif.	5,022	12,431.8	620.0	5.0	6.4	14.9
16	16	**Tandy** Ft. Worth	4,648	4,648.1	263.3	5.7	9.0	16.8
17	17	**Eastman Kodak** Rochester, N.Y.	4,140	18,908.0	703.0	3.7	2.9	10.4
18	23	**Intel** Santa Clara, Calif.	3,921	3,921.3	650.3	16.6	12.1	18.1
19	18	**Lockheed** Calabasas, Calif.	3,880	9,958.0	335.0	3.4	4.9	14.5
20	27	**Compaq Computer** Houston	3,599	3,598.8	454.9	12.6	16.7	24.5
21	21	**3M** St. Paul	3,530	13,021.0	1,308.0	10.0	11.8	21.4
22	19	**Ford Motor** Dearborn, Mich.	3,250	97,650.0	860.1	0.9	0.5	3.7
23	29	**Westinghouse Electric** Pittsburgh	3,196	12,915.0	268.0	2.1	1.2	6.9
24	20	**Litton Industries** Beverly Hills, Calif.	3,166	5,155.6	169.9	3.3	3.4	13.8
25	30	**Harris** Melbourne, Fla.	3,065	3,064.9	36.0	1.2	5.0	12.1
26	22	**Martin Marietta** Bethesda, Md.	2,983	6,125.9	327.6	5.3	10.4	21.3
27	28	**TRW** Cleveland	2,980	8,169.0	208.0	2.5	3.7	10.9
28	26	**ITT** New York	2,925	20,604.0	1,056.0	5.1	2.2	12.4
29	25	**Allied-Signal** Morristown, N.J.	2,840	12,343.0	462.0	3.7	4.4	13.7
30	39	**Sun Microsystems** Mountain View, Calif.	2,763	2,762.8	151.0	5.5	6.3	12.0
31	40	**Seagate Technology** Scotts Valley, Calif.	2,668	2,667.6	99.7	3.7	6.3	17.4
32	32	**Boeing** Seattle	2,600	27,595.0	1,385.0	5.0	9.5	19.9
33	33	**AMP** Harrisburg, Pa.	2,587	3,043.6	287.1	9.4	9.8	16.0
34	36	**GTE** Stamford, Conn.	2,500	18,374.0	1,541.0	8.4	4.6	16.9
35	34	**DuPont** Wilmington, Del.	2,480	40,047.0	2,310.0	5.8	6.1	14.1
36	35	**Emerson Electric** St. Louis	2,396	7,727.9	618.1	8.0	9.6	20.5
37	31	**Wang Laboratories** Lowell, Mass.	2,369	2,368.7	-583.6	-24.6	-32.3	-151.5
38	37	**Pitney Bowes** Stamford, Conn.	2,283	3,195.6	213.3	6.7	3.4	13.0
39	38	**Amdahl** Sunnyvale, Calif.	2,159	2,158.8	184.0	8.5	7.9	13.4
40	42	**McDonnell Douglas** St. Louis	1,915	15,255.0	275.0	1.7	1.8	7.8
41	41	**Tandem Computers** Cupertino, Calif.	1,873	1,873.1	98.1	5.2	6.5	10.1
42	54	**Loral** New York	1,789	1,789.3	84.8	4.7	5.1	13.3
43	43	**National Semiconductor** Santa Clara, Calif.	1,731	1,730.7	-169.6	-9.8	-2.1	-3.6
44	24	**Control Data** Minneapolis	1,691	1,691.0	2.7	0.2	0.2	0.6
45	46	**E-Systems** Dallas	1,650	1,810.2	94.3	5.2	9.7	15.1
46	44	**Avnet** Great Neck, N.Y.	1,547	1,756.4	56.6	3.2	4.9	7.3
47	61	**Microsoft** Redmond, Wash.	1,478	1,477.8	355.6	24.1	25.3	30.4
48	45	**Zenith Electronics** Glenview, Ill.	1,410	1,409.9	-53.2	-3.8	-7.2	-15.3
49	47	**Tektronix** Beaverton, Ore.	1,396	1,395.9	-70.1	-5.0	-9.5	-24.1
50	58	**Johnson Controls Inc.** Milwaukee	1,350	4,581.5	88.6	1.9	3.3	8.9

NA = not available
NM = not meaningful

* compounded average annual growth rate
** See "Notes to the ELECTRONIC BUSINESS 200" on page 67.

Return on investment	Cost of goods % of sales	R & D % of sales	Sales/employee ($thousands)	Profits/employee ($thousands)	Five-year growth (CAAGR)*		Capital outlays to net cash flow after dividends	Debt to capital	Foreign sales % of sales	Fiscal year ended	Industry segment codes**
					sales	profits					
9.7%	36.8%	9.5%	$184.6	$16.1	6.4%	-1.7%	76.1%	31.3%	60.7%	12/90	7, 10
13.4	34.5	6.5	136.2	10.0	1.6	11.9	76.7	30.9	0.0	12/90	—
3.6	43.9	6.2	137.2	6.1	8.4	9.9	48.2	63.0	50.7	12/90	13
8.8	48.6	10.3	143.8	8.0	15.3	8.6	79.4	24.2	54.4	10/90	7, 1
0.9	46.3	12.5	104.4	0.6	14.1	-30.1	118.0	1.9	56.3	6/90	12
6.4	70.8	4.8	122.1	6.0	4.3	29.3	113.3	10.8	16.2	12/90	8
8.3	56.0	9.3	103.7	4.8	14.8	47.3	105.6	29.6	54.2	12/90	2, 15
-6.1	60.0	7.4	134.3	-5.8	15.0	NM	-334.4	51.7	51.8	12/90	10
5.0	49.4	2.5	196.0	14.4	12.4	13.6	88.1	74.7	25.9	12/90	—
-1.3	72.9	8.2	93.4	-0.6	5.9	NM	222.8	24.1	33.2	12/90	8, 15
15.3	63.8	4.4	104.6	6.2	8.4	15.7	45.8	29.9	31.8	12/90	7, 9
16.0	49.2	8.0	114.3	6.7	7.8	3.2	67.0	22.6	61.9	12/90	7, 10
30.3	43.2	8.6	382.6	32.7	23.7	50.6	36.0	7.8	41.7	9/90	5
12.9	76.5	2.9	120.8	7.3	7.7	8.2	55.5	34.1	17.4	12/90	8
11.3	74.3	13.7	121.5	6.1	1.8	1.0	51.3	24.5	26.2	9/90	—
10.9	50.9	0.0	115.4	7.4	11.6	9.0	33.8	35.5	6.7	6/90	4
5.0	51.1	7.0	140.6	5.2	12.2	16.2	14.9	52.5	46.5	12/90	—
15.4	41.8	13.2	164.1	27.2	23.5	233.8	72.1	14.8	46.0	12/90	15
7.8	48.5	4.5	136.4	4.6	1.5	-3.4	57.7	46.3	7.1	12/90	—
23.5	53.4	5.2	315.7	39.9	48.2	76.5	55.0	3.8	53.9	12/90	5
17.2	52.3	6.6	145.3	14.6	9.9	14.5	88.5	19.7	47.8	12/90	—
0.7	75.4	3.6	263.6	2.3	13.1	-19.3	210.2	80.4	36.7	12/90	—
1.7	76.3	1.5	111.3	2.3	2.8	-14.8	167.8	75.8	21.3	12/90	—
11.3	73.7	3.2	101.9	3.5	2.4	-9.6	48.6	18.0	26.5	7/90	8
7.1	58.7	4.8	91.4	3.9	9.2	10.2	70.0	41.0	27.8	6/90	7, 8
16.1	78.8	3.5	98.8	5.3	6.7	5.6	57.4	24.3	0.0	12/90	—
5.9	73.4	3.8	108.1	2.8	6.7	9.2	106.1	45.7	31.2	12/90	—
5.8	83.8	2.7	180.7	9.3	0.6	29.1	57.3	52.7	31.5	12/90	—
7.5	82.7	5.8	116.7	4.4	8.6	NM	286.8	44.8	38.8	12/90	—
8.5	48.8	12.2	214.6	9.7	84.5	67.1	69.1	29.0	57.1	6/90	5
9.4	74.8	4.3	63.5	3.1	62.2	157.0	39.7	46.0	35.3	6/90	14
19.0	84.6	3.0	170.7	8.6	15.0	19.6	91.4	4.3	58.3	12/90	—
12.9	59.0	8.6	123.2	11.6	13.2	21.6	93.9	19.7	59.3	12/90	3
6.9	59.1	1.5	119.3	10.0	5.0	NM	107.5	59.2	16.6	12/90	—
8.9	50.7	3.6	278.2	16.0	6.3	15.6	140.6	36.9	54.3	12/90	—
13.9	62.5	3.1	102.8	8.3	9.0	8.1	51.5	32.1	36.1	9/90	—
-60.7	48.5	8.9	123.7	-31.1	1.4	NM	-37.2	59.9	52.5	6/90	12
4.5	30.3	3.4	106.7	6.9	12.3	9.8	97.1	65.1	23.4	12/90	13
12.6	50.6	14.4	241.2	20.6	20.2	49.8	94.6	6.2	47.9	12/90	10
3.0	81.1	3.8	134.1	2.3	7.4	-4.5	54.3	61.4	21.8	12/90	—
8.6	28.9	13.6	170.6	11.1	24.0	29.4	120.5	15.2	55.6	9/90	12
7.6	52.4	5.5	100.3	6.1	20.5	13.0	44.9	42.8	29.0	3/90	8
-3.3	64.0	15.1	51.2	-0.9	7.1	NM	129.4	8.5	45.4	5/90	15
0.3	59.7	7.5	116.6	0.2	-14.4	NM	33.2	44.0	32.4	12/90	10, 7
12.5	82.6	0.0	98.2	5.1	14.3	9.6	50.5	17.0	7.2	12/90	8
5.8	73.3	0.0	233.5	7.5	2.7	2.7	27.0	21.0	0.0	6/90	6
30.2	17.4	15.3	210.0	49.5	53.2	63.2	48.6	0.7	54.9	6/90	16
-10.6	89.0	4.0	52.2	-1.9	1.3	NM	-240.0	30.7	6.1	12/90	4
-14.3	46.7	13.8	101.0	-6.6	-0.4	NM	-263.3	40.4	46.2	5/90	9
5.1	81.3	1.4	103.5	2.1	20.6	6.2	110.6	43.0	17.2	9/90	—

(continued)

THE ELECTRONIC BUSINESS

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FINANCIAL TABLES 51-100

Rank			Calendar year 1990				Fiscal year 1990	
1990	**1989**	**Company** Location	**Electronics sales** ($ millions)	**Total sales** ($ millions)	**Net profits** ($ millions)	**Profits % of sales**	**Return on assets**	**Return on equity**
51	73	**Conner Peripherals** San Jose	$1,338	$1,337.6	$130.1	9.7%	14.8%	21.5%
52	52	**Computer Associates** Garden City, N.Y.	1,311	1,310.7	162.0	12.4	10.9	15.9
53	48	**Varian Associates** Palo Alto, Calif.	1,296	1,295.5	16.8	1.3	1.4	3.1
54	53	**United Technologies** Hartford	1,265	21,442.0	750.6	3.5	4.7	14.0
55	50	**Chrysler** Highland Park, Mich.	1,265	30,620.0	68.0	0.2	0.1	1.0
56	51	**Data General** Westborough, Mass.	1,237	1,237.4	-106.9	-8.6	-15.4	-34.5
57	56	**SCI Systems** Huntsville, Ala.	1,175	1,175.3	13.5	1.2	0.4	1.3
58	59	**Storage Technology** Louisville, Colo.	1,141	1,140.6	70.6	6.2	6.7	13.3
59	55	**General Dynamics** St. Louis	1,095	10,173.0	-639.0	-6.3	-9.7	-42.3
60	60	**Western Digital** Irvine, Calif.	1,066	1,066.5	-78.6	-7.4	3.8	7.5
61	57	**Advanced Micro Devices** Sunnyvale, Calif.	1,059	1,059.2	-53.6	-5.1	-4.8	-8.4
62	72	**Oracle Systems** Redwood Shores, Calif.	1,059	1,058.9	57.4	5.4	14.9	30.3
63	69	**Intergraph** Huntsville, Ala.	1,045	1,044.6	62.6	6.0	6.9	9.2
64	65	**Grumman** Bethpage, N.Y.	990	3,990.4	85.6	2.1	3.5	9.5
65	63	**Arrow Electronics** Melville, N.Y.	971	970.9	10.1	1.0	2.1	6.7
66	62	**Teledyne** Los Angeles	940	3,445.8	69.2	2.0	4.2	13.2
67	66	**Eaton** Cleveland	930	3,639.0	169.0	4.6	5.6	14.8
68	67	**Northrop** Los Angeles	923	5,489.8	210.4	3.8	6.8	20.4
69	70	**Beckman Instruments** Fullerton, Calif.	815	815.2	36.2	4.4	5.3	11.1
70	75	**Medtronic** Minneapolis	811	976.8	124.2	12.7	12.7	20.1
71	71	**Cray Research** Eagan, Minn.	804	804.4	113.0	14.0	12.0	18.0
72	64	**General Signal** Stamford, Conn.	800	1,694.9	-13.3	-0.8	-1.0	-2.9
73	93	**Maxtor** San Jose	789	789.4	10.8	1.4	4.9	12.1
74	86	**Corning** Corning, N.Y.	783	2,940.5	289.1	9.8	8.2	15.6
75	78	**EG&G** Wellesley, Mass.	762	2,474.3	74.0	3.0	11.0	20.0
76	68	**Emerson Radio**[1] North Bergen, N.J.	735	735.0	NA	0.0	3.1	11.0
77	109	**Quantum** Milpitas, Calif.	716	716.3	66.7	9.3	19.4	30.7
78	74	**Perkin-Elmer** Norwalk, Conn.	711	863.2	46.9	5.4	5.2	11.3
79	81	**Lotus Development** Cambridge, Mass.	685	684.5	23.3	3.4	3.5	7.5
80	82	**LSI Logic** Milpitas, Calif.	655	655.5	-34.0	-5.2	-4.3	-12.3
81	80	**Molex** Lisle, Ill.	649	649.2	65.9	10.1	10.2	12.9
82	88	**AST Research** Irvine, Calif.	586	586.5	52.5	9.0	10.8	18.1
83	79	**Scientific-Atlanta** Atlanta	574	574.5	34.0	5.9	11.4	15.9
84	83	**Applied Materials** Santa Clara, Calif.	573	572.9	27.2	4.7	6.1	11.3
85	84	**Marshall Industries** El Monte, Calif.	565	564.6	19.1	3.4	9.0	14.9
86	85	**Raychem** Menlo Park, Calif.	560	1,196.3	-117.0	-9.8	-8.8	-16.1
87	111	**Dell Computer** Austin, Tex.	546	546.2	27.2	5.0	10.3	24.3
88	97	**Novell** Provo, Utah	526	526.3	109.7	20.8	19.1	23.7
89	105	**Eli Lilly** Indianapolis	520	5,191.6	1,127.3	21.7	15.8	32.5
90	96	**DSC Communications** Plano, Tex.	519	519.3	20.3	3.9	2.7	7.3
91	92	**Analog Devices** Norwood, Mass.	509	508.7	-10.0	-2.0	-2.7	-3.8
92	115	**Reliance Electric** Cleveland	500	1,547.0	49.0	3.2	4.2	34.0
93	89	**Penn Central** Cincinnati	490	2,154.3	97.8	4.5	2.8	6.0
94	95	**Westmark International** Seattle	485	484.9	18.7	3.9	4.1	5.9
95	103	**Dynatech** Burlington, Mass.	485	484.8	17.5	3.6	5.4	10.8
96	122	**Silicon Graphics** Mountain View, Calif.	482	482.1	39.8	8.3	8.9	13.2
97	94	**Monsanto** St. Louis	475	8,995.0	546.0	6.1	5.9	13.4
98	87	**Teradyne** Boston	459	458.9	-21.3	-4.6	-5.5	-7.8
99	99	**United Telecomm** Kansas City, Mo.	455	8,345.1	308.7	3.7	2.9	13.4
100	102	**Vishay Intertechnology** Malvern, Pa.	446	445.6	23.2	5.2	5.3	13.0

NA = not available
NM = not meaningful

* compounded average annual growth rate
** See "Notes to the ELECTRONIC BUSINESS 200" on page 67.

[1] calendar year electronics sales and total sales are ELECTRONIC BUSINESS estimates

Return on investment	Cost of goods % of sales	R & D % of sales	Sales/ employee ($thousands)	Profits/ employee ($thousands)	Five-year growth (CAAGR)* sales	Five-year growth (CAAGR)* profits	Capital outlays to net cash flow after dividends	Debt to capital	Foreign sales % of sales	Fiscal year ended	Industry segment codes**
20.2%	72.9%	4.7%	$140.8	$13.7	NA	NA	57.8%	6.3%	49.0%	12/90	14
15.5	-8.5	13.2	187.8	22.9	41.6%	48.9%	8.5	3.0	48.0	3/90	16
2.6	65.7	6.1	124.0	1.2	7.5	-22.9	112.4	17.8	41.5	9/90	9, 7
8.4	71.5	4.8	111.3	3.9	7.4	3.4	102.4	40.0	36.6	12/90	—
0.2	71.8	3.0	278.5	0.6	7.6	-47.1	149.9	77.0	12.2	12/90	—
-26.6	47.1	11.6	114.8	-13.2	-0.4	NM	-420.9	22.9	52.0	9/90	12
0.5	89.8	3.4	110.3	0.2	17.0	-30.0	164.9	64.5	35.9	6/90	—
9.5	58.1	8.6	125.3	7.8	11.1	NM	32.9	28.8	42.1	12/90	14
-24.1	92.8	3.8	103.7	-6.5	4.9	NM	-106.3	43.0	0.0	12/90	—
5.0	71.1	7.7	140.7	3.2	41.4	NM	120.5	32.8	45.6	6/90	14
-6.5	51.9	19.2	88.3	-4.5	5.9	NM	472.5	23.2	35.7	12/90	15
22.6	12.0	9.1	142.5	17.2	111.1	137.6	55.3	25.4	49.3	5/90	16
8.9	45.9	10.5	108.8	6.5	14.7	-1.6	67.7	3.0	47.2	12/90	5
5.1	90.2	2.9	152.9	3.3	5.2	1.0	32.4	46.5	4.9	12/90	—
2.8	77.7	0.0	425.9	4.4	13.8	NM	34.3	58.4	0.0	12/90	6
6.7	77.7	1.8	103.8	2.1	1.1	-33.9	98.0	49.4	11.1	12/90	—
8.6	71.1	3.5	99.4	4.6	5.4	-2.8	68.1	41.7	24.3	12/90	—
10.4	83.1	2.8	143.7	5.5	1.7	-0.4	35.6	48.9	0.0	12/90	—
8.6	42.8	9.9	115.6	5.1	8.2	6.6	88.9	22.5	54.9	12/90	11
17.1	27.8	9.5	123.5	16.0	18.1	23.3	42.8	14.8	39.6	4/90	11
14.7	23.2	16.0	165.6	23.3	16.2	8.5	22.2	18.4	40.7	12/90	10
-1.5	67.7	6.1	107.3	-0.8	1.0	NM	495.6	47.6	19.1	12/90	—
6.4	72.1	7.2	104.4	4.0	56.7	NM	103.3	47.4	33.0	3/90	14
11.5	58.3	4.2	102.8	10.1	10.9	21.2	66.7	26.4	28.1	12/90	—
15.9	86.5	0.9	82.5	2.5	15.6	4.5	24.2	20.5	7.0	12/90	—
3.3	89.6	0.0	800.2	9.3	20.2	-7.7	30.4	69.7	0.0	3/90	4
30.7	69.3	5.8	584.9	61.9	30.0	17.6	31.8	0.0	32.0	3/90	14
7.8	49.0	7.6	130.0	6.9	12.4	15.0	31.6	31.0	53.0	7/90	9
4.9	12.9	15.0	195.6	6.6	24.9	-9.4	67.1	34.9	47.6	12/90	16
-6.5	56.4	9.2	149.0	-7.7	36.2	NM	73.9	47.5	43.8	12/90	15
12.7	47.7	5.5	88.4	9.2	18.6	15.0	62.8	1.9	71.1	6/90	3
15.6	65.4	3.5	230.9	15.2	31.0	13.0	24.0	14.0	34.4	6/90	5
15.5	63.9	6.5	170.6	12.3	7.1	22.0	50.8	2.5	19.0	6/90	2
8.9	50.4	17.1	172.9	10.4	26.6	30.0	221.9	21.2	54.6	10/90	—
11.3	76.0	0.0	341.9	12.6	15.4	31.2	72.4	24.4	0.0	5/90	6
-12.3	43.6	11.0	100.7	-10.1	10.4	NM	-247.3	23.6	63.4	6/90	—
22.9	65.0	4.1	271.4	13.5	74.6	104.4	26.2	6.0	34.3	1/91	5
23.4	22.2	11.9	194.6	36.9	55.2	80.4	24.2	1.1	39.6	10/90	16
22.6	24.6	13.5	173.6	37.7	15.6	18.0	108.9	30.4	36.1	12/90	—
3.7	55.8	10.0	128.4	5.0	24.3	NM	116.9	49.3	10.8	12/90	2
-3.4	40.7	16.6	85.1	-2.3	8.5	NM	112.8	8.7	53.0	10/90	15
6.4	68.1	5.9	110.5	3.5	6.0	30.4	48.8	81.1	14.1	12/90	—
4.5	49.0	0.0	109.4	5.0	8.7	4.5	43.2	24.3	1.0	12/90	—
5.8	49.7	11.8	133.6	4.5	20.6	NM	62.4	2.8	31.5	12/90	11
6.8	44.4	9.6	144.7	4.9	12.6	-5.7	44.1	37.0	26.7	3/90	2
11.4	39.8	10.9	200.0	15.4	66.8	NM	54.4	13.7	43.4	6/90	5
8.6	51.4	6.8	219.0	13.3	5.9	NM	71.9	35.3	42.3	12/90	—
-7.0	54.1	14.6	104.3	-4.8	3.1	NM	180.9	10.5	43.3	12/90	9
4.6	74.4	0.0	193.6	7.2	89.4	53.7	133.1	65.9	0.0	12/90	—
6.7	62.9	1.5	53.6	2.7	51.8	24.0	62.6	48.6	45.0	12/90	3

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THE ELECTRONIC BUSINESS 200

FINANCIAL TABLES 101-150

Rank 1990	Rank 1989	**Company** Location	Calendar year 1990 Electronics sales ($ millions)	Total sales ($ millions)	Net profits ($ millions)	Profits % of sales	Fiscal year 1990 Return on assets	Return on equity
101	104	**3Com** Santa Clara, Calif.	$437	$437.4	$23.9	5.5%	7.0%	8.8%
102	113	**Mentor Graphics** Wilsonville, Ore.	435	435.2	23.6	5.4	4.7	7.2
103	108	**Diebold** Canton, Ohio	428	476.1	37.5	7.9	5.2	7.2
104	107	**Everex Systems** Fremont, Calif.	428	427.6	-0.8	-0.2	10.9	17.5
105	—	**ESCO Electronics** St. Louis	425	531.9	-2.5	-0.5	-0.3	-0.5
106	90	**Dover** New York	425	2,210.3	155.7	7.0	10.6	19.8
107	114	**Tandon** Moorpark, Calif.	422	421.8	25.6	6.1	10.1	25.2
108	110	**Premier Industrial** Cleveland	416	639.4	76.6	12.0	23.3	29.7
109	100	**Atari** Sunnyvale, Calif.	411	411.5	-20.8	-5.1	-7.6	-20.6
110	117	**Mark IV Industries** Amherst, N.Y.	410	872.2	24.3	2.8	3.2	16.4
111	128	**Anthem Electronics** San Jose	408	408.2	23.2	5.7	15.9	19.2
112	130	**Applied Magnetics** Goleta, Calif.	404	404.0	9.1	2.3	-3.1	-6.0
113	123	**Stratus Computer** Marlborough, Mass.	404	403.9	37.0	9.2	11.5	16.1
114	119	**Polaroid** Cambridge, Mass.	400	1,971.7	151.0	7.7	8.9	27.1
115	98	**M/A-Com** Burlington, Mass.	382	382.4	15.9	4.2	-8.6	-29.8
116	112	**MAI Systems** Tustin, Calif.	382	382.0	-79.9	-20.9	-16.3	-162.7
117	132	**Micropolis** Chatsworth, Calif.	381	380.6	7.9	2.1	3.6	9.9
118	125	**Andrew** Orlando Park, Ill.	380	379.9	18.5	4.9	5.7	9.1
119	127	**Wyle Laboratories** El Segundo, Calif.	359	449.5	12.7	2.8	6.5	12.0
120	106	**Micron Technology** Boise, Idaho	347	347.1	-4.4	-1.3	0.7	1.0
121	131	**Pioneer-Standard** Cleveland	342	342.4	8.1	2.4	4.0	12.8
122	186	**Archive** Costa Mesa, Calif.	332	332.3	8.8	2.7	3.6	11.5
123	101	**Smith Corona** New Canaan, Conn.	328	415.7	18.1	4.4	15.1	50.0
124	138	**VLSI Technology** San Jose	325	324.8	-12.7	-3.9	-3.9	-8.7
125	126	**Cubic** San Diego	316	343.8	22.2	6.4	8.4	16.1
126	121	**Sprague Technologies** Stamford, Conn.	315	314.6	2.2	0.7	0.7	1.3
127	146	**Inmac** Santa Clara, Calif.	307	307.2	3.8	1.2	3.1	8.4
128	136	**Sequa** New York	305	2,211.0	32.7	-1.5	1.3	4.6
129	129	**Watkins-Johnson** Palo Alto, Calif.	303	311.9	13.0	4.2	5.8	9.1
130	140	**Savin** Stamford, Conn.	302	377.7	0.3	0.1	0.0	1.9
131	135	**Imo Industries** Lawrenceville, N.J.	300	1,018.1	21.2	2.1	1.9	6.3
132	118	**LTV** Dallas	300	6,138.3	70.9	1.2	1.1	-1.5
133	133	**Augat** Mansfield, Mass.	299	299.2	1.1	0.4	6.3	8.2
134	120	**Concurrent Computer** Tinton Falls, N.J.	296	296.2	-59.8	-20.2	-13.9	NM
135	137	**Textron** Providence	290	7,917.5	283.0	3.6	1.9	10.6
136	157	**Sundstrand** Rockford, Ill.	290	1,599.8	115.6	7.2	7.3	18.5
137	167	**QMS** Mobile, Ala.	286	286.3	15.1	5.3	8.6	18.7
138	—	**Acuson** Mountain View, Calif.	283	282.8	47.8	16.9	19.2	23.9
139	166	**Thomas & Betts** Bridgewater, N.J.	282	599.0	48.4	8.1	8.3	13.8
140	139	**Executone** Darien, Conn.	281	280.5	1.3	0.5	15.0	2.5
141	149	**Audiovox** Hauppauge, N.Y.	280	308.1	-3.2	-1.0	-2.2	-5.2
142	156	**Olin** Stamford, Conn.	280	2,592.0	84.0	3.2	4.5	11.7
143	134	**Gerber Scientific** South Windsor, Conn.	280	279.8	15.1	5.4	11.7	15.8
144	155	**Tyco Laboratories** Exeter, N.H.	280	2,576.0	125.2	4.9	8.4	19.6
145	173	**ADC Telecommunications** Minneapolis	271	270.7	23.8	8.8	12.6	17.1
146	144	**Bally Manufacturing** Chicago	270	2,082.2	-292.3	-14.0	-10.1	-87.9
147	150	**Chips and Technologies** San Jose	269	268.7	11.8	4.4	14.5	21.9
148	142	**Datapoint** San Antonio	268	267.5	-63.2	-23.6	-36.0	-137.7
149	185	**Diasonics** Milpitas, Calif.	267	267.1	16.4	6.1	5.9	11.3
150	145	**Bolt Beranek and Newman** Cambridge, Mass.	266	266.4	-22.2	-8.3	-18.7	-80.6

NA = not available
NM = not meaningful

* compounded average annual growth rate
** See "Notes to the ELECTRONIC BUSINESS 200" on page 67.

Return on investment	Cost of goods % of sales	R & D % of sales	Sales/ employee ($thousands)	Profits/ employee ($thousands)	Five-year growth (CAAGR)* sales	profits	Capital outlays to net cash flow after dividends	Debt to capital	Foreign sales % of sales	Fiscal year ended	Industry segment codes**
8.8%	46.4%	10.4%	$215.0	$10.5	47.7%	29.9%	59.9%	0.7%	40.3%	5/90	2
6.1	34.8	17.1	158.5	8.6	26.1	24.2	82.2	16.0	48.4	12/90	16
7.1	67.4	4.3	124.8	7.1	2.9	-2.3	112.0	1.2	19.2	12/90	1
16.0	69.9	6.4	175.7	9.8	87.6	93.4	30.4	8.5	12.8	7/90	5, 14
-0.4	75.5	0.0	86.8	-0.4	1.3	NM	-3,381.8	4.9	18.3	9/90	8
14.2	65.1	2.8	108.0	7.6	9.0	9.3	28.1	28.0	34.4	12/90	—
17.8	68.4	2.7	365.2	22.1	38.2	NM	26.2	29.4	95.8	12/90	5
29.0	50.4	0.5	133.2	15.9	7.7	14.2	24.1	2.5	0.0	5/90	6
-11.7	76.6	5.6	326.6	-16.5	23.7	NM	-25.1	43.3	88.7	12/90	4
3.8	60.6	2.5	91.5	3.0	84.8	57.7	44.4	76.8	12.5	2/90	—
19.2	76.5	0.0	701.3	39.9	27.8	30.7	27.1	0.0	0.0	12/90	6
-3.9	72.7	8.5	31.5	-0.9	25.0	NM	260.7	35.6	49.2	9/90	3
14.8	35.4	14.2	169.6	15.5	38.2	33.8	45.8	8.0	45.8	12/90	12
11.5	46.9	7.2	167.5	12.8	20.4	NM	65.0	57.8	46.3	12/90	—
-16.3	65.8	3.4	78.7	-6.6	-2.3	NM	-187.1	45.5	23.8	9/90	8
-26.3	50.0	2.8	105.2	-17.4	NA	NA	-24.3	83.8	59.7	9/90	16
4.9	77.0	5.3	126.0	2.6	32.0	23.3	28.4	50.2	68.5	12/90	14
6.8	56.9	6.2	114.4	5.7	11.2	5.2	70.7	25.2	55.2	9/90	2
8.9	75.2	0.0	214.4	6.1	11.5	53.0	30.0	25.7	0.0	1/91	6
0.8	53.3	10.7	92.6	1.4	34.4	99.8	95.9	16.9	22.7	8/90	15
5.8	76.4	0.0	371.1	6.7	8.2	12.6	131.2	54.6	0.0	3/90	6
4.8	59.2	7.6	87.1	3.4	38.4	62.0	76.9	58.4	27.7	9/90	14
24.4	71.6	2.0	131.0	9.3	13.8	NA	24.5	51.3	34.6	6/90	13
-4.7	47.0	16.5	155.6	-6.1	32.8	NM	97.7	45.8	44.5	12/90	15
11.3	68.5	1.0	110.2	7.2	2.4	10.3	8.0	29.3	0.0	9/90	8, 7
1.0	75.8	1.0	78.4	0.5	-4.0	NM	75.0	18.5	46.1	12/90	3
5.0	64.8	0.0	203.1	2.5	25.3	11.8	65.0	40.4	58.5	7/90	0
1.8	72.3	1.0	119.5	1.8	46.6	22.6	136.8	61.1	31.2	12/90	—
7.9	61.3	7.9	98.1	4.1	6.0	-6.7	74.1	12.3	32.1	12/90	8
0.2	62.5	0.0	185.8	0.1	-1.0	NM	144.1	89.1	15.4	12/90	13
2.6	69.9	1.5	111.9	2.3	21.5	20.0	68.3	59.5	36.8	12/90	3
-1.5	86.3	0.4	173.9	2.0	-5.6	NM	129.9	0.0	0.0	12/90	—
7.5	65.6	4.5	110.8	6.3	3.2	7.3	68.4	8.4	27.1	12/90	3
1.9	41.0	12.7	123.7	-15.1	49.7	NM	8,899.4	NM	43.5	6/90	12
2.9	52.4	2.5	146.6	5.2	16.2	11.1	461.2	73.1	13.6	12/90	—
11.6	59.2	7.8	123.1	8.9	4.5	9.2	61.9	37.2	7.6	12/90	—
11.5	59.9	3.1	200.5	10.6	33.0	22.9	36.5	38.4	38.0	9/90	14
23.9	36.2	9.5	231.2	39.1	NA	NA	30.3	0.0	21.8	12/90	11
10.2	52.4	3.1	122.3	9.9	11.5	7.2	99.3	26.1	44.8	12/90	—
1.1	59.7	2.5	122.0	0.5	NA	NA	17.4	58.1	0.0	12/90	2
-2.7	81.0	0.0	446.6	-4.6	14.3	NM	-288.8	47.3	0.0	11/90	4
6.5	74.8	2.5	170.5	5.5	8.0	NM	118.4	44.4	15.9	12/90	—
14.7	46.0	6.7	144.2	15.2	6.5	5.3	18.0	7.2	50.0	4/90	1
12.0	73.5	0.4	146.0	8.3	27.6	26.9	33.6	39.1	0.0	5/90	—
16.3	46.0	9.8	123.1	10.8	15.8	23.8	36.9	4.4	16.0	10/90	2
-25.9	61.7	0.9	79.6	-11.2	16.7	NM	-122.7	70.5	0.0	12/90	—
19.9	51.7	15.5	441.2	44.1	NA	NA	35.0	9.2	0.0	6/90	15
-58.8	54.6	3.2	147.7	-49.1	-12.5	NM	-21.8	57.3	91.2	7/90	2
9.2	58.5	6.2	175.7	10.8	19.0	42.0	50.8	19.1	54.4	12/90	11
-26.5	55.8	12.1	113.9	-15.1	13.6	NM	-80.7	67.2	14.6	6/90	8

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THE ELECTRONIC BUSINESS

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FINANCIAL TABLES 150-200

Rank			Calendar year 1990				Fiscal year 1990	
1990	1989	**Company** Location	Electronics sales ($ milions)	Total sales ($ milions)	Net profits ($ milions)	Profits % of sales	Return on assets	Return on equity
151	141	**Measurex** Cupertino, Calif.	$266	$266.2	$22.5	8.5%	6.7%	9.4%
152	143	**Ball** Muncie, Ind.	265	1,357.2	50.2	3.7	3.8	12.4
153	—	**Millipore** Bedford, Mass.	260	703.2	27.8	4.0	3.8	6.4
154	158	**Reynolds and Reynolds** Dayton, Ohio	257	607.3	22.7	3.7	4.7	10.4
155	154	**Logicon** Torrance, Calif.	257	256.5	8.6	3.3	8.4	12.0
156	153	**Genicom** Waynesboro, Va.	255	255.3	1.1	0.4	0.7	2.6
157	147	**Figgie International** Willoughby, Ohio	253	1,361.0	39.7	2.9	3.7	11.3
158	151	**CTS** Elkhart, Ind.	251	251.0	7.3	2.9	4.3	6.0
159	171	**Pittway** Northbrook, Ill.	250	944.1	24.1	2.5	3.2	6.2
160	—	**Thermo Electron** Waltham, Mass.	250	708.0	33.9	4.8	3.8	11.0
161	172	**AM International** Chicago	250	889.0	-39.5	-4.4	-6.1	-22.6
162	187	**Ask Computer Systems** Mountain View, Calif.	250	249.7	4.7	1.9	3.0	4.4
163	—	**Sequent Computer Systems** Beaverton, Ore.	249	248.8	18.8	7.6	7.5	9.7
164	175	**International Rectifier** El Segundo, Calif.	248	247.7	10.6	4.3	1.0	10.0
165	163	**Square D** Palatine, Ill.	246	1,653.3	116.6	7.1	8.0	19.2
166	180	**Ametek** Paoli, Pa.	245	660.7	37.3	5.7	6.1	18.7
167	162	**Bell Industries** Los Angeles	245	399.6	7.6	1.9	4.7	8.6
168	189	**Sun Electric** Crystal Lake, Ill.	242	242.0	3.3	1.4	1.8	3.2
169	152	**Cooper Industries** Houston	240	6,222.2	361.4	5.8	5.0	11.8
170	165	**Esterline** Bellevue, Wash.	239	373.0	6.0	1.6	2.4	9.9
171	—	**Autodesk** Sausalito, Calif.	238	237.9	56.8	23.9	21.4	26.0
172	193	**Teradata** El Segundo, Calif.	238	237.8	5.1	2.2	7.5	11.6
173	164	**Cincinnati Milacron** Cincinnati	235	837.7	-22.1	-2.6	-3.2	-8.9
174	161	**Fluke** Everett, Wash.	233	233.4	11.2	4.8	8.0	10.3
175	170	**Symbol Technologies** Bohemia, N.Y.	231	231.5	7.6	3.3	2.4	3.3
176	—	**Cadence Design Systems** San Jose	231	231.4	38.0	16.4	16.3	24.0
177	148	**Ashton-Tate** Torrance, Calif.	231	230.5	-18.1	-7.8	-7.4	-10.7
178	183	**Becton Dickinson** Franklin Lakes, N.J.	230	2,066.1	184.0	8.9	7.0	14.8
179	—	**Allen Group** Melville, N.Y.	227	352.3	-1.3	-0.4	-0.4	-1.0
180	181	**Cypress Semiconductor** San Jose	225	225.2	33.2	14.8	10.7	13.7
181	—	**Qume** Milpitas, Calif.	219	219.5	-15.2	-6.9	8.6	19.5
182	—	**Hubbell** Orange, Conn.	218	719.5	86.0	12.0	13.8	18.4
183	168	**Anacomp** Indianapolis	217	662.1	2.3	0.3	0.8	-16.0
184	—	**Solectron** San Jose	216	216.1	7.8	3.6	8.3	20.6
185	—	**Encore Computer** Ft. Lauderdale, Fla.	215	215.2	-30.1	-14.0	-18.6	NM
186	177	**Kollmorgen** Simsbury, Conn.	215	238.5	3.9	1.7	1.9	4.7
187	196	**Sensormatic Electronics** Deerfield Beach, Fla.	213	212.6	21.9	10.3	7.6	10.0
188	191	**Tellabs** Lisle, Ill.	211	211.0	8.1	3.8	4.7	6.2
189	159	**Recognition Equipment** Irving, Tex.	210	210.0	-24.4	-11.6	-17.5	-80.2
190	—	**Convex Computer** Richardson, Tex.	209	209.3	18.4	8.8	6.9	12.9
191	—	**Silicon Valley Group** San Jose	207	207.1	2.1	1.0	2.4	6.3
192	—	**Northgate Computer** Eden Prairie, Minn.	203	203.4	-6.9	-3.4	-14.1	NM
193	—	**Pyramid Technology** Mountain View, Calif.	200	200.5	18.4	9.2	8.7	10.9
194	179	**General DataComm** Middlebury, Conn.	199	199.4	-0.3	-0.2	0.3	0.7
195	178	**Integrated Device Technology** Santa Clara, Calif.	199	198.9	3.8	1.9	6.5	13.0
196	—	**Morton International** Chicago	198	1,798.9	139.2	7.7	7.4	13.4
197	176	**Ultimate** East Hanover, N.J.	197	196.9	-39.8	-20.2	0.1	0.1
198	182	**Coherent** Palo Alto, Calif.	194	193.8	-1.2	-0.6	-0.3	-0.5
199	—	**Borland International** Scotts Valley, C [illegible]	191	190.8	22.6	11.8	13.6	21.9
200	190	**BancTec** Dallas	190	189.8	11.7	6.2	6.7	15.0

NA = not available
NM = not meaningful

* compounded average annual growth rate
** See "Notes to the ELECTRONIC BUSINESS 200" on page 67.

Return on investment	Cost of goods % of sales	R & D % of sales	Sales/ employee ($thousands)	Profits/ employee ($thousands)	Five-year growth (CAAGR)*		Capital outlays to net cash flow after dividends	Debt to capital	Foreign sales % of sales	Fiscal year ended	Industry segment codes**
					sales	profits					
9.2%	56.7%	7.6%	$103.2	$8.7	8.6%	4.9%	62.0%	2.1%	64.1%	11/90	1
5.6	81.9	0.9	108.5	4.0	3.8	-0.7	45.9	54.7	0.0	12/90	—
4.6	40.3	8.7	114.7	4.5	13.9	-2.6	152.4	27.7	56.7	12/90	9
6.4	54.1	1.7	117.0	4.8	12.3	3.0	44.3	38.5	10.9	9/90	—
12.0	79.6	0.9	84.5	2.8	8.8	0.9	30.3	0.0	0.0	3/90	8
0.9	69.2	3.4	88.2	0.4	15.1	-9.4	38.8	67.4	35.2	12/90	14
5.0	71.1	1.1	85.1	2.5	10.6	10.1	117.2	55.3	0.0	12/90	—
5.2	75.3	0.0	45.3	1.3	-0.8	-1.5	71.5	12.7	25.3	12/90	3
4.5	58.6	2.1	111.1	2.8	11.8	-5.0	201.2	28.0	25.9	12/90	—
6.4	62.5	7.4	116.8	5.6	28.1	28.6	46.4	41.8	35.4	12/90	—
-11.6	68.0	2.9	117.9	-5.6	11.6	NM	-42.7	48.5	46.2	7/90	—
4.3	46.7	8.0	220.0	5.3	21.2	-9.0	21.4	2.0	16.6	6/90	16
8.9	34.4	10.4	146.3	11.1	124.9	NM	130.6	7.7	30.8	12/90	10
1.3	65.9	2.9	88.5	0.8	11.1	-21.5	39.2	87.2	58.0	6/90	15
11.8	62.3	2.8	85.7	6.0	6.2	2.7	71.7	38.7	19.4	12/90	—
8.3	70.4	1.7	108.3	6.1	15.2	6.7	83.6	55.4	16.9	12/90	—
6.7	73.7	0.0	226.2	4.7	5.4	4.0	1,675.6	22.9	0.0	6/90	6
2.4	53.7	2.6	100.7	1.4	8.1	NM	62.6	23.9	43.7	12/90	9
7.2	63.5	0.0	108.2	6.3	15.2	21.7	62.2	39.2	32.4	12/90	—
3.2	57.4	4.4	100.6	1.8	8.9	39.8	54.0	67.9	34.9	10/90	9
26.0	5.9	10.3	215.8	51.5	51.8	54.1	34.8	0.0	55.5	1/91	16
10.1	32.2	13.0	143.4	12.0	139.8	NM	103.7	13.1	24.4	6/90	10
-5.3	74.5	4.1	113.0	-3.0	4.6	NM	-196.6	40.6	32.8	12/90	—
10.2	47.5	8.5	107.2	5.6	1.5	-4.3	56.2	1.1	35.7	9/90	9
3.0	43.8	3.8	120.8	4.0	75.4	95.5	88.3	9.9	63.3	12/90	1
22.0	9.2	18.4	138.1	22.7	70.4	NM	38.2	8.4	48.5	12/90	16
-10.3	13.8	17.2	142.3	-11.2	13.7	NM	90.3	3.6	62.5	12/90	16
8.9	47.5	5.1	108.8	9.9	14.0	17.7	95.7	39.8	41.5	9/90	—
-0.5	61.2	0.3	125.8	-0.5	2.4	NM	460.3	48.3	14.0	12/90	9
13.2	26.8	24.7	141.2	20.8	66.9	NM	54.8	3.8	22.0	12/90	15
14.0	76.4	3.7	194.6	9.3	33.1	NM	46.8	28.3	44.9	2/90	14
18.0	65.3	0.0	129.7	15.5	6.7	12.5	42.3	1.7	9.5	12/90	—
1.1	55.3	0.6	130.4	1.1	42.0	6.3	39.6	106.8	28.1	9/90	—
13.8	80.2	0.8	102.4	3.7	25.0	47.1	36.1	33.0	0.0	8/90	—
-25.6	49.0	14.8	128.2	-18.0	237.6	NM	-97.5	120.1	38.7	12/90	12
2.7	62.1	4.4	95.4	1.6	6.5	NM	72.6	42.8	42.8	12/90	—
9.1	35.8	2.9	133.6	14.0	18.3	21.8	29.1	9.1	36.0	5/90	1
6.0	51.1	15.0	103.5	4.0	16.1	3.1	80.4	3.5	30.3	12/90	2
-25.6	64.8	4.3	152.2	-20.9	7.2	NM	-19.4	68.1	57.9	10/90	1
8.7	35.0	13.0	172.3	15.2	73.0	NM	76.7	32.5	40.4	12/90	10
4.4	57.5	13.7	109.0	2.6	38.0	-4.9	88.1	30.6	36.1	9/90	—
-57.9	73.3	0.5	291.8	-9.9	NA	NA	-58.6	126.6	3.0	12/90	5
10.8	37.6	11.3	149.8	14.0	39.6	41.4	79.0	0.7	40.1	9/90	10
0.5	45.4	10.4	98.7	0.2	1.1	-47.7	32.5	35.0	35.0	9/90	2
8.1	35.0	19.9	100.2	8.1	40.4	-64.5	83.7	37.6	24.0	3/90	15
10.0	63.8	2.9	168.9	13.9	NA	NA	65.2	25.3	30.4	6/90	—
0.1	56.7	2.8	287.3	0.2	14.8	-60.1	140.5	16.1	33.1	4/90	16
-0.4	55.8	11.5	125.9	-0.3	7.7	NA	96.0	14.7	46.4	9/90	9
18.3	16.5	12.6	194.3	20.2	57.8	66.0	15.7	16.1	33.9	3/90	16
9.1	65.5	6.1	104.0	5.9	22.0	NA	52.8	39.2	16.0	3/90	1

THE ELECTRONIC BUSINESS 200

INDUSTRY SEGMENTS

Fiscal year 1990

Company 200 rank	**Sales/ employee** ($thousands)	rank	**Cost of goods % of sales**	rank	**R&D % of sales**	rank	**Capital expenditures % of sales**	rank	**Foreign sales % of sales**	rank
1 ◄ Industry segment code **COMPUTER-BASED SYSTEMS**										
BancTec 200	**$104.0**	7	**65.5%**	2	**6.1%**	4	**5.9%**	3	**16.0%**	8
Diebold 103	**124.8**	5	**67.4**	1	**4.3**	5	**4.7**	5	**19.2**	7
Gerber Scientific 143	**144.2**	2	**46.0**	6	**6.7**	3	**2.3**	7	**50.0**	5
Hewlett-Packard 4	**143.8**	3	**48.6**	5	**10.3**	1	**7.2**	1	**54.4**	4
Measurex 151	**103.2**	8	**56.7**	4	**7.6**	2	**5.8**	4	**64.1**	1
Recognition Equipment 189	**152.2**	1	**64.8**	3	**4.3**	5	**1.4**	8	**57.6**	3
Sensormatic Electronics 187	**133.6**	4	**35.8**	8	**2.9**	8	**4.2**	6	**36.0**	6
Symbol Technologies 175	**120.8**	6	**43.8**	7	**3.8**	7	**6.6**	2	**63.3**	2
Weighted average	$141.1		49.5%		9.7%		6.9%		52.9%	
2 ◄ Industry segment code **COMMUNICATIONS**										
3Com 101	**$215.0**	1	**46.4%**	8	**10.4%**	2	**6.1%**	5	**40.3%**	4
ADC Telecommunications 145	**123.1**	6	**46.0**	9	**9.8**	5	**5.3**	6	**16.0**	9
Andrew 118	**114.4**	8	**56.9**	3	**6.2**	9	**6.9**	3	**55.2**	2
Datapoint 148	**147.7**	3	**54.6**	6	**3.2**	10	**5.1**	7	**91.2**	1
DSC Communications 90	**128.4**	5	**55.8**	5	**10.0**	4	**13.1**	1	**10.8**	10
Dynatech 95	**144.7**	4	**44.4**	11	**9.8**	5	**3.5**	9	**26.7**	7
Executone Information Systems 140	**122.0**	7	**59.7**	2	**2.5**	11	**0.6**	11	**0.0**	11
General DataComm Industries 194	**98.7**	11	**45.4**	10	**10.4**	2	**2.5**	10	**35.0**	5
Motorola 7	**103.7**	9	**56.0**	4	**9.3**	7	**11.5**	2	**54.2**	3
Scientific-Atlanta 83	**170.6**	2	**63.9**	1	**6.5**	8	**4.5**	8	**19.0**	8
Tellabs 188	**103.5**	10	**51.1**	7	**15.0**	1	**6.3**	4	**30.3**	6
Weighted average	$110.3		55.3%		9.0%		10.1%		48.2%	
3 ◄ Industry segment code **COMPONENTS**										
AMP 33	**$123.2**	1	**59.0%**	7	**8.6%**	1	**11.1%**	2	**59.3%**	2
Applied Magnetics 112	**31.5**	8	**72.7**	3	**8.5**	2	**10.8**	3	**49.2**	3
Augat 133	**110.8**	3	**65.6**	5	**4.5**	4	**6.0**	5	**27.1**	7
CTS 158	**45.3**	7	**75.3**	2	**0.0**	8	**4.7**	7	**25.3**	8
Imo Industries 131	**111.9**	2	**69.9**	4	**1.5**	5	**3.3**	8	**36.8**	6
Molex 81	**88.4**	4	**47.7**	8	**5.5**	3	**12.2**	1	**71.1**	1
Sprague Technologies 126	**78.4**	5	**75.8**	1	**1.0**	7	**4.9**	6	**46.1**	4
Vishay Intertechnology 100	**53.6**	6	**62.9**	6	**1.5**	5	**6.8**	4	**45.0**	5
Weighted average	$86.9		62.5%		5.8%		8.8%		51.7%	
4 ◄ Industry segment code **CONSUMER**										
Atari 109	**$326.6**	3	**76.6%**	4	**5.6%**	1	**1.0%**	4	**88.7%**	1
Audiovox 141	**446.6**	2	**81.0**	3	**0.0**	3	**1.3**	3	**0.0**	4
Emerson Radio 76	**800.2**	1	**89.6**	1	**0.0**	3	**.8**	5	**0.0**	4
Tandy 16	**115.4**	4	**50.9**	5	**0.0**	3	**2.5**	1	**6.7**	2
Zenith Electronics 48	**52.2**	5	**89.0**	2	**4.0**	2	**2.3**	2	**6.1**	3
Weighted average	$108.9		65.2%		1.0%		2.1%		10.0%	

Includes only companies with electronics sales over 50% of total
See "Notes to the ELECTRONIC BUSINESS 200" on page 67.

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INDUSTRY SEGMENTS

Fiscal year 1990

◀ Industry segment code

5 DESKTOP COMPUTERS

Company 200 rank	Sales/ employee ($ thousands)	rank	Cost of goods % of sales	rank	R&D % of sales	rank	Capital expenditures % of sales	rank	Foreign sales % of sales	rank
Apple Computer 13	$382.6	1	43.2%	9	8.6%	4	4.0%	5	41.7%	6
AST Research 82	230.9	6	65.4	4	3.5	8	2.1	7	34.4	7
Compaq Computer 20	315.7	3	53.4	6	5.2	6	9.0	1	53.9	3
Dell Computer 87	271.4	5	65.0	5	4.1	7	1.7	10	34.3	8
Everex Systems 104	175.7	9	69.9	2	6.4	5	2.2	6	12.8	9
Intergraph 63	108.8	10	45.9	8	10.5	3	7.6	3	47.2	4
Northgate Computer 192	291.8	4	73.3	1	0.5	10	2.1	7	3.0	10
Silicon Graphics 96	200.0	8	39.8	10	10.9	2	7.1	4	43.4	5
Sun Microsystems 30	214.6	7	48.8	7	12.2	1	8.6	2	57.1	2
Tandon 107	385.2	2	68.4	3	2.7	9	1.9	9	95.8	1
Weighted average	$263.6		50.0%		7.9%		6.0%		47.1%	

◀ Industry segment code

6 DISTRIBUTION

Company 200 rank	Sales/ employee ($ thousands)	rank	Cost of goods % of sales	rank	R&D % of sales	rank	Capital expenditures % of sales	rank	Foreign sales % of sales	rank
Anthem Electronics 111	$701.3	1	76.5%	2	0.0%	—	1.7%	4	0.0%	—
Arrow Electronics 65	425.9	2	77.7	1	0.0	—	0.6	8	0.0	—
Avnet 46	233.5	5	73.3	7	0.0	—	1.0	6	0.0	—
Bell Industries 167	225.2	6	73.7	6	0.0	—	1.4	5	0.0	—
Marshall Industries 85	341.9	4	76.0	4	0.0	—	3.1	2	0.0	—
Pioneer-Standard 121	371.1	3	76.4	3	0.0	—	3.2	1	0.0	—
Premier Industrial 108	133.2	8	50.4	8	0.5	—	2.3	3	0.0	—
Wyle Laboratories 119	214.4	7	75.2	5	0.0	—	1.0	6	0.0	—
Weighted average	$255.9		72.3%		0.1%		1.5%		0.0%	

◀ Industry segment code

7 DIVERSIFIED

Company 200 rank	Sales/ employee ($ thousands)	rank	Cost of goods % of sales	rank	R&D % of sales	rank	Capital expenditures % of sales	rank	Foreign sales % of sales	rank
Control Data 44	$116.6	4	59.7%	4	7.5%	4	2.3%	7	32.4%	5
Cubic 125	110.2	6	68.5	1	1.0	8	0.7	8	0.0	8
Harris 25	91.4	8	58.7	5	4.8	6	6.3	4	27.8	7
Hewlett-Packard 4	143.8	2	48.6	7	10.3	1	7.2	2	54.4	3
Honeywell 11	104.6	7	63.8	3	4.4	7	4.0	6	31.8	6
IBM 1	184.6	1	36.8	8	9.5	2	9.4	1	60.7	2
NCR 12	114.3	5	49.2	6	8.0	3	6.4	3	61.9	1
Varian Associates 53	124.0	3	65.7	2	6.1	5	4.3	5	41.5	4
Weighted average	$157.5		42.3%		8.9%		8.3%		56.2%	

◀ Industry segment code

8 GOVERNMENT

Company 200 rank	Sales/ employee ($ thousands)	rank	Cost of goods % of sales	rank	R&D % of sales	rank	Capital expenditures % of sales	rank	Foreign sales % of sales	rank
Bolt Beranek and Newman 150	$113.9	3	55.8%	12	12.1%	1	4.3%	7	14.8%	10
Cubic 125	110.2	4	68.5	8	1.0	10	0.7	13	0.0	12
ESCO Electronics 105	86.8	10	75.5	4	0.0	12	3.3	10	18.3	7
E-Systems 45	98.2	7	82.8	1	0.0	12	3.3	10	7.2	11
GM Hughes Electronics 6	122.1	1	70.8	7	4.8	5	7.5	2	16.2	9
Harris 25	91.4	9	58.7	11	4.8	5	6.3	3	27.8	4
Litton Industries 24	101.9	5	73.7	5	3.2	8	3.7	9	25.5	5
Logicon 155	84.5	11	78.6	2	0.9	11	1.4	12	0.0	12
Loral 42	100.3	6	52.4	13	5.5	4	4.8	5	29.0	3
M/A-Com 115	78.7	12	65.8	9	3.4	7	4.7	6	23.8	6
Raytheon 14	120.8	2	76.5	3	2.9	9	4.2	8	17.4	8
Texas Instruments 10	93.4	9	72.9	6	8.2	2	13.8	1	33.2	1
Watkins-Johnson 129	98.1	8	61.3	10	7.3	3	5.4	4	32.1	2
Weighted average	$107.5		71.7%		4.5%		6.7%		21.3%	

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Company 200 rank	**Sales/ employee** ($ thousands)	rank	**Cost of goods % of sales**	rank	**R&D % of sales**	rank	**Capital expenditures % of sales**	rank	**Foreign sales % of sales**	rank
9 ◄ Industry segment code **INSTRUMENTS & MEASUREMENT**										
Allen Group 179	**$125.8**	3	**61.2%**	3	**0.3%**	11	**1.9%**	11	**14.0%**	11
Coherent 198	**125.9**	2	**55.8**	5	**11.5**	3	**3.6**	7	**46.4**	3
Esterline 170	**100.6**	11	**57.4**	4	**4.4**	8	**3.4**	8	**34.9**	9
Fluke 174	**107.2**	6	**47.5**	9	**8.5**	5	**4.6**	4	**35.7**	8
Honeywell 11	**104.6**	7	**63.8**	2	**4.4**	9	**4.0**	6	**31.8**	10
Millipore 153	**114.7**	5	**40.3**	11	**8.7**	4	**9.7**	1	**56.7**	1
Perkin-Elmer 78	**130.0**	1	**49.8**	8	**7.8**	6	**1.7**	11	**53.0**	2
Sun Electric 168	**100.7**	10	**53.7**	7	**2.8**	10	**2.3**	9	**43.7**	5
Tektronix 49	**101.0**	9	**46.7**	10	**13.8**	2	**6.9**	2	**46.2**	4
Teradyne 98	**104.3**	8	**54.1**	6	**14.6**	1	**5.2**	3	**43.3**	6
Varian Associates 53	**124.0**	4	**65.7**	1	**6.1**	7	**4.3**	5	**41.5**	7
Weighted average	$108.5		58.5%		6.5%		4.5%		37.8%	
10 ◄ Industry segment code **MAINFRAMES**										
Amdahl 39	**$241.2**	1	**50.6%**	3	**14.4%**	2	**14.1%**	4	**47.9%**	4
Control Data 44	**116.6**	9	**59.7**	2	**7.5**	9	**2.3**	11	**32.4**	8
Convex Computer 190	**172.3**	3	**35.0**	7	**13.0**	3	**12.0**	5	**40.4**	6
Cray Research 71	**165.6**	4	**23.2**	10	**16.0**	1	**7.8**	7	**40.7**	5
IBM 1	**184.6**	2	**36.8**	6	**9.5**	7	**9.4**	6	**60.7**	2
NCR 12	**114.3**	10	**49.2**	4	**8.0**	8	**6.4**	8	**61.9**	1
Pyramid Technology 193	**149.8**	5	**37.6**	5	**11.3**	5	**14.3**	3	**40.1**	7
Sequent Computer Systems 163	**146.3**	6	**34.4**	8	**10.4**	6	**19.0**	1	**30.8**	9
Teradata 172	**143.4**	7	**32.2**	9	**13.0**	3	**15.3**	2	**24.4**	10
Unisys 8	**134.3**	8	**60.0**	1	**7.4**	10	**4.6**	9	**51.8**	3
Weighted average	$169.0		40.9%		9.3%		8.7%		58.5%	
11 ◄ Industry segment code **MEDICAL**										
Acuson 138	**$231.2**	1	**36.2%**	4	**9.5%**	3	**5.9%**	3	**21.8%**	5
Beckman Instruments 69	**115.6**	5	**42.8**	3	**9.9**	2	**8.3**	1	**54.9**	1
Diasonics 149	**175.7**	2	**58.5**	1	**6.2**	5	**4.5**	4	**54.4**	2
Medtronic 70	**123.5**	4	**27.8**	5	**9.5**	3	**6.6**	2	**39.6**	3
Westmark International 94	**133.6**	3	**49.7**	2	**11.8**	1	**3.9**	5	**31.5**	4
Weighted average	$133.0		40.2%		9.7%		6.3%		42.4%	
12 ◄ Industry segment code **MINICOMPUTERS**										
Concurrent Computer 134	**$123.7**	4	**41.0%**	5	**12.7%**	4	**4.2%**	7	**43.5%**	6
Data General 56	**114.8**	6	**47.1**	3	**11.6**	6	**7.0**	3	**52.0**	4
Digital Equipment 5	**104.4**	7	**46.3**	4	**12.5**	5	**7.9**	2	**56.3**	1
Encore Computer 185	**128.2**	3	**49.0**	1	**14.8**	1	**4.9**	6	**38.7**	7
Stratus Computer 113	**169.6**	2	**35.4**	6	**14.2**	2	**6.8**	4	**45.8**	5
Tandem Computers 41	**170.6**	1	**28.9**	7	**13.6**	3	**16.1**	1	**55.6**	2
Wang Laboratories 37	**123.7**	4	**48.5**	2	**8.9**	7	**6.1**	5	**52.5**	3
Weighted average	$112.9		44.7%		12.1%		8.3%		54.8%	
13 ◄ Industry segment code **OFFICE EQUIPMENT**										
Pitney Bowes 38	**$106.7**	4	**30.3%**	4	**3.4%**	2	**10.1%**	1	**23.4%**	3
Savin 130	**185.8**	1	**62.5**	2	**0.0**	4	**9.6**	2	**15.4**	4
Smith Corona 123	**131.0**	3	**71.6**	1	**2.0**	3	**1.7**	4	**34.6**	2
Xerox 3	**137.2**	2	**43.9**	3	**6.2**	1	**3.3**	3	**50.7**	1
Weighted average	$131.0		42.6%		5.5%		4.6%		44.6%	

(continued)

THE ELECTRONIC BUSINESS 200

INDUSTRY SEGMENTS

Fiscal year 1990

◄ Industry segment code

14 PERIPHERALS

Company 200 rank	Sales/ employee ($ thousands)	rank	Cost of goods % of sales	rank	R&D % of sales	rank	Capital expenditures % of sales	rank	Foreign sales % of sales	rank
Archive 122	**$87.1**	11	**59.2%**	11	**7.8%**	3	**7.2%**	3	**27.7%**	11
Conner Peripherals 51	**148.8**	5	**72.9**	4	**4.7**	8	**7.1**	4	**49.0**	2
Everex Systems 104	**175.7**	4	**69.9**	7	**6.4**	5	**2.2**	11	**12.8**	12
Sonicom 156	**88.2**	10	**69.2**	9	**3.4**	11	**2.2**	11	**35.2**	8
Maxtor 73	**104.4**	9	**72.1**	5	**7.2**	4	**9.1**	1	**33.0**	9
Micropolis 117	**126.0**	7	**77.8**	1	**5.3**	7	**2.3**	10	**68.5**	1
QMS 137	**200.5**	2	**59.9**	10	**3.1**	12	**3.3**	8	**38.0**	6
Quantum 77	**504.9**	1	**69.3**	8	**5.8**	6	**3.7**	7	**32.0**	10
Qume 181	**194.6**	3	**76.4**	2	**3.7**	10	**2.9**	9	**44.9**	4
Seagate Technology 31	**83.5**	12	**74.8**	3	**4.3**	9	**4.2**	6	**35.3**	7
Storage Technology 58	**125.3**	8	**58.1**	12	**8.0**	1	**5.2**	5	**42.1**	5
Western Digital 60	**140.7**	6	**71.1**	6	**7.7**	2	**8.1**	2	**45.8**	3
Weighted average	$104.4		70.2%		5.8%		5.3%		39.6%	

◄ Industry segment code

15 SEMICONDUCTORS

Company 200 rank	Sales/ employee ($ thousands)	rank	Cost of goods % of sales	rank	R&D % of sales	rank	Capital expenditures % of sales	rank	Foreign sales % of sales	rank
Advanced Micro Devices 61	**$88.3**	11	**51.9%**	7	**19.2%**	3	**28.7%**	1	**35.7%**	8
Analog Devices 91	**85.1**	12	**40.7**	11	**16.6**	4	**7.9**	11	**53.0**	3
Chips and Technologies 147	**441.2**	1	**51.7**	8	**15.5**	6	**4.6**	12	**0.0**	13
Cypress Semiconductor 180	**141.2**	5	**26.8**	13	**24.7**	1	**16.2**	5	**22.0**	12
Integrated Device Technology 195	**100.2**	7	**35.0**	12	**19.9**	2	**16.7**	4	**24.0**	10
Intel 18	**164.1**	2	**41.8**	10	**13.2**	8	**17.3**	3	**46.0**	4
International Rectifier 164	**88.5**	10	**65.9**	2	**2.9**	13	**2.4**	13	**58.0**	1
LSI Logic 80	**149.0**	4	**56.4**	4	**9.2**	11	**9.5**	10	**43.8**	7
Micron Technology 120	**92.6**	9	**53.3**	6	**10.7**	9	**24.0**	2	**22.7**	11
Motorola 7	**103.7**	6	**56.0**	5	**9.3**	10	**11.5**	7	**54.2**	2
National Semiconductor 43	**51.2**	13	**64.0**	3	**15.1**	7	**10.9**	8	**45.4**	5
Texas Instruments 10	**93.4**	8	**72.9**	1	**8.2**	12	**13.8**	6	**33.2**	9
VLSI Technology 124	**155.6**	3	**47.8**	9	**16.5**	5	**10.9**	8	**44.5**	6
Weighted average	$100.7		57.6%		10.8%		13.5%		44.7%	

◄ Industry segment code

16 SOFTWARE

Company 200 rank	Sales/ employee ($ thousands)	rank	Cost of goods % of sales	rank	R&D % of sales	rank	Capital expenditures % of sales	rank	Foreign sales % of sales	rank
Ashton-Tate 177	**$142.3**	11	**13.8%**	8	**17.2%**	2	**5.1%**	9	**62.5%**	1
Ask Computer Systems 162	**220.0**	2	**46.7**	3	**8.0**	11	**1.5**	13	**16.6**	13
Autodesk 171	**215.8**	3	**5.9**	12	**10.3**	9	**8.8**	4	**55.5**	3
Borland International 199	**194.3**	7	**16.5**	7	**12.6**	7	**2.5**	10	**33.9**	11
Cadence Design Systems 176	**138.1**	12	**9.2**	11	**18.4**	1	**9.6**	2	**48.5**	6
Computer Associates 52	**187.8**	8	**-8.5**	13	**13.2**	6	**1.8**	12	**48.0**	8
Lotus Development 79	**195.6**	5	**12.9**	9	**15.0**	5	**7.5**	6	**47.6**	9
MAI Systems 116	**105.2**	13	**50.6**	2	**2.8**	12	**2.4**	11	**59.7**	2
Mentor Graphics 102	**158.5**	9	**34.8**	4	**17.1**	3	**8.0**	5	**48.4**	7
Microsoft 47	**218.3**	4	**17.4**	6	**15.3**	4	**13.4**	1	**54.9**	4
Novell 88	**194.6**	6	**22.2**	5	**11.9**	8	**5.7**	8	**39.6**	10
Oracle Systems 62	**142.5**	10	**12.0**	10	**9.1**	10	**9.2**	3	**49.3**	5
Ultimate 197	**287.3**	1	**56.7**	1	**2.8**	12	**7.0**	7	**33.1**	12
Weighted average	$173.7		15.8%		12.4%		7.1%		48.6%	

Includes only companies with electronics sales over 50% of total
See "Notes to the ELECTRONIC BUSINESS 200" on page 67.

THE ELECTRONIC BUSINESS 200

Notes to the ELECTRONIC BUSINESS 200

Sales
Sales includes sales of products, services and rentals, but excludes dividends, interest and other non-operating revenue.

Profits
Profits is income from continuing operations after taxes and before extraordinary items or charges if any are shown on the income statement.

Debt to total capital
Debt to total capital includes long-term and short-term debt as a percentage of shareholders' equity plus long-term and short-term debt.

Return on equity
ROE is profits as a percentage of shareholders' equity (preferred stock, capital stock, surpluses and retained earnings) at the company's fiscal year end.

Capital expenditures
Capital expenditures (investment in property, plant, and equipment) are measured as a percentage of profits from continuing operations plus depreciation, minus cash dividends paid.

Return on investment
ROI is profits as a percentage of shareholders' equity, short-term and long-term debt. Short-term debt includes the current portion of long-term debt, notes payable, and other borrowings.

Cost of goods sold
COGS includes manufacturing costs of products, services, and rentals sold, minus depreciation as a percentage of total sales.

Research and development
R&D is company-sponsored research and development expenses as a percentage of total sales.

Employees
The number of employees is supplied by each company. In most cases this number represents year-end employment.

Return on assets
ROA is profits as a percentage of total assets at the company's fiscal year end.

Foreign sales
Foreign sales include U.S. operations' export sales and sales from operations outside the U.S. to unaffiliated customers.

Industry segment classification
Companies are classified in the industry segments that represents the greatest volume of their sales. For purposes of comparison, only companies with electronic sales comprising 50% or more of total sales are included in the industry segment weighted averages. (In previous years electronics sales of 70% or more of total sales were required.)

Comparisons of companies in like industry segments should be made with caution. For example, Wyle Laboratories Inc. is classified under distribution because 80% of its sales are in this category. The remaining 20% of sales are from service. However, sales per employee and other ratios are calculated from total company figures. A company like Wyle may find its productivity ranking for example, to be lower compared with other distributors that get 100% of sales from distribution. Comparisons between two years must also be made with caution as companies acquire or sell off divisions.

Industry segment codes

1 Computer-based systems
2 Communications
3 Components (other than semiconductors)
4 Consumer
5 Desktop computers
6 Distribution
7 Diversified
8 Government
9 Instruments & measurement
10 Mainframes
11 Medical
12 Minicomputers
13 Office equipment
14 Peripherals
15 Semiconductors
16 Software

Newcomers to the 200

Company	1990 Rank
Acuson	138
Allen Group	179
Autodesk	171
Borland International	199
Cadence Design Systems	176
Convex Computer	190
Encore Computer	185
ESCO Electronics [1]	105
Hubbell [2]	182
Millipore	153
Morton International	196
Northgate Computer	192
Pyramid Technology	193
Qume	181
Sequent Computer Systems	163
Silicon Valley Group	191
Solectron	184
Thermo Electron	160

[1] spin-off by Emerson Electric Co., Oct. 1989
[2] acquired Brand-Rex Telecom Division-Modular Products Group, July 1990

Displaced from the 200

Company	1989 Rank
Burr-Brown	197
Cipher Data Products [1]	184
Contel [2]	77
Dataproducts [3]	124
Digital Communications	174
Dynascan	160
Flextronics	192
Foxboro [4]	116
General Instrument [5]	49
GenRad	188
Hadco	200
Intermec	199
KLA Instruments	198
LPL Technologies [6]	76
Network Equipment	194
TIE/Communications	169
Valid Logic Systems	195
Wyse Technology [7]	91

[1] acquired by Archive (#122) Apr. 1990
[2] acquired by GTE Corp. (#34) Mar. 1991
[3] acquired by Hitachi Koko and Nissei Sangyo May 1990
[4] acquired by Siebe plc Sept. 1990
[5] acquired by Forstmann Little & Co. Aug. 1990
[6] went private May 1990
[7] acquired by Channel International Corp. of Taiwan Jan. 1990

THE ELECTRONIC BUSINESS 200

ALPHABETICAL INDEX

Company	200 Rank
3Com Corp.	101
3M Co.	21
Acuson Corp.	138
ADC Telecommunications Inc.	145
Advanced Micro Devices Inc.	61
Allen Group Inc., The	179
Allied-Signal Inc.	29
AM International Inc.	161
Amdahl Corp.	39
Ametek Inc.	166
AMP Inc.	33
Anacomp Inc.	183
Analog Devices Inc.	91
Andrew Corp.	118
Anthem Electronics Inc.	111
Apple Computer Inc.	13
Applied Magnetics Corp.	112
Applied Materials Inc.	84
Archive Corp.	122
Arrow Electronics Inc.	65
Ashton-Tate Corp.	177
Ask Computer Systems Inc.	162
AST Research Inc.	82
AT&T	2
Atari Corp.	109
Audiovox Corp.	141
Augat Inc.	133
Autodesk Inc.	171
Avnet Inc.	46
Ball Corp.	152
Bally Manufacturing Corp.	146
BancTec Inc.	200
Beckman Instruments Inc.	69
Becton, Dickinson and Co.	178
Bell Industries Inc.	167
Boeing Co., The	32
Bolt Beranek and Newman Inc.	150
Borland International Inc.	199
Cadence Design Systems Inc.	176
Chips and Technologies Inc.	147
Chrysler Corp.	55
Cincinnati Milacron Inc.	173
Coherent Inc.	198
Compaq Computer Corp.	20
Computer Associates International Inc.	52
Concurrent Computer Corp.	134
Conner Peripherals Inc.	51
Control Data Corp.	44
Convex Computer Corp.	190
Cooper Industries Inc.	169
Corning Inc.	74
Cray Research Inc.	71
CTS Corp.	158
Cubic Corp.	125
Cypress Semiconductor Corp.	180
Data General Corp.	56
Datapoint Corp.	148
Dell Computer Corp.	87
Diasonics Inc.	149
Diebold Inc.	103
Digital Equipment Corp.	5
Dover Corp.	106
DSC Communications Corp.	90
DuPont, De Nemours & Co., E.I.	35
Dynatech Corp.	95
Eastman Kodak Co.	17
Eaton Corp.	67
EG&G Inc.	75
Eli Lilly and Co.	89
Emerson Electric Co.	36
Emerson Radio Corp.	76
Encore Computer Corp.	185
ESCO Electronics Corp.	105
Esterline Corp.	170
Everex Systems Inc.	104
Executone Information Systems Inc.	140
E-Systems Inc.	45
Figgie International Inc.	157
Fluke Mfg. Co., John	174
Ford Motor Co.	22
General DataComm Industries Inc.	194
General Dynamics Corp.	59
General Electric Co.	9
General Signal Corp.	72
Genicom Corp.	156
Gerber Scientific Inc.	143
GM Hughes Electronics Corp.	6
Grumman Corp.	64
GTE Corp.	34
Harris Corp.	25
Hewlett-Packard Co.	4
Honeywell Inc.	11
Hubbell Inc.	182
IBM	1
Imo Industries Inc.	131
Inmac Corp.	127
Integrated Device Technology Inc.	195
Intel Corp.	18
Intergraph Corp.	63
International Rectifier Corp.	164
ITT Corp.	28
Johnson Controls Inc.	50
Kollmorgen Corp.	186
Litton Industries Inc.	24
Lockheed Corp.	19
Logicon Inc.	155
Loral Corp.	42
Lotus Development Corp.	79
LSI Logic Corp.	80
LTV Corp., The	132
MAI Systems Corp.	116
Mark IV Industries Inc.	110
Marshall Industries	85
Martin Marietta Corp.	26
Maxtor Corp.	73
McDonnell Douglas Corp.	40
Measurex Corp.	151
Medtronic Inc.	70
Mentor Graphics Corp.	102
Micron Technology Inc.	120
Micropolis Corp.	117
Microsoft Corp.	47
Millipore Corp.	153
Molex Inc.	81
Monsanto Co.	97
Morton International Inc.	196
Motorola Inc.	7
M/A-Com Inc.	115
National Semiconductor Corp.	43
NCR Corp.	12
Northgate Computer Corp.	192
Northrop Corp.	68
Novell Inc.	88
Olin Corp.	142
Oracle Systems Corp.	62
Penn Central Corp.	93
Perkin-Elmer Corp., The	78
Pioneer-Standard Electronics Inc.	121
Pitney Bowes Inc.	38
Pittway Corp.	159
Polaroid Corp.	114
Premier Industrial Corp.	108
Pyramid Technology Corp.	193
QMS Inc.	137
Quantum Corp.	77
Qume Corp.	181
Raychem Corp.	86
Raytheon Co.	14
Recognition Equipment Inc.	189
Reliance Electric Co.	92
Reynolds and Reynolds Co., The	154
Rockwell International Corp.	15
Savin Corp.	130
SCI Systems Inc.	57
Scientific-Atlanta Inc.	83
Seagate Technology Inc.	31
Sensormatic Electronics Corp.	187
Sequa Inc.	128
Sequent Computer Systems Inc.	163
Silicon Graphics Inc.	96
Silicon Valley Group Inc.	191
Smith Corona Corp.	123
Solectron Corp.	184
Sprague Technologies Inc.	126
Square D Co.	165
Storage Technology Corp.	58
Stratus Computer Inc.	113
Sun Electric Corp.	168
Sun Microsystems Inc.	30
Sundstrand Corp.	136
Symbol Technologies Inc.	175
Tandem Computers Inc.	41
Tandon Corp.	107
Tandy Corp.	16
Tektronix Inc.	49
Teledyne Inc.	66
Tellabs Inc.	188
Teradata Corp.	172
Teradyne Inc.	98
Texas Instruments Inc.	10
Textron Inc.	135
Thermo Electron Corp.	160
Thomas & Betts Corp.	139
TRW Inc.	27
Tyco Laboratories Inc.	144
Ultimate Corp., The	197
Unisys Corp.	8
United Technologies Corp.	54
United Telecommunications Inc.	99
Varian Associates Inc.	53
Vishay Intertechnology Inc.	100
VLSI Technology Inc.	124
Wang Laboratories Inc.	37
Watkins-Johnson Co.	129
Western Digital Corp.	60
Westinghouse Electric Corp.	23
Westmark International Inc.	94
Wyle Laboratories Inc.	119
Xerox Corp.	3
Zenith Electronics Corp.	48

Overall profits continue three-year slide

Software companies dominate the earnings scene, joined by a mix of semiconductor, computer, and medical equipment manufacturers

By Dwight B. Davis

Not since 1985 have the top 200 U.S. electronics companies had such a tough time making money as in 1990. Amid war jitters and a faltering U.S. economy, 38 companies saw red ink last year, and the ELECTRONIC BUSINESS 200's average profits dropped to 4.38%—down from 4.83% in 1989 and 5.13% in 1988.

The recession that plagued many electronics manufacturers in late 1990 continues to dull overall earnings into 1991. But some economists expect a broad-based industrial upswing this year. "We're projecting a midyear upturn out of the recession, with 2% to 3% growth in the second half," says John Ryding, senior economist at Bear, Stearns & Co. in New York. Already aiding profits this year are lower interest rates, which will help companies keep their interest costs under control. Ryding predicts earnings of $23.25 per share for the Standard & Poor 500 in 1991, up 8.8% from last year's $21.37 per-share earnings.

As usual, the software sector of the ELECTRONIC BUSINESS 200 performed well despite war, recession, and interest rates, and set the pace for profitability in 1990. The top 3 companies in the profitability ranking—and 6 of the top 15—are software producers. Nevertheless, the sector was by no means invulnerable: Both Ashton-Tate Corp. and The Ultimate Corp. lost millions last year.

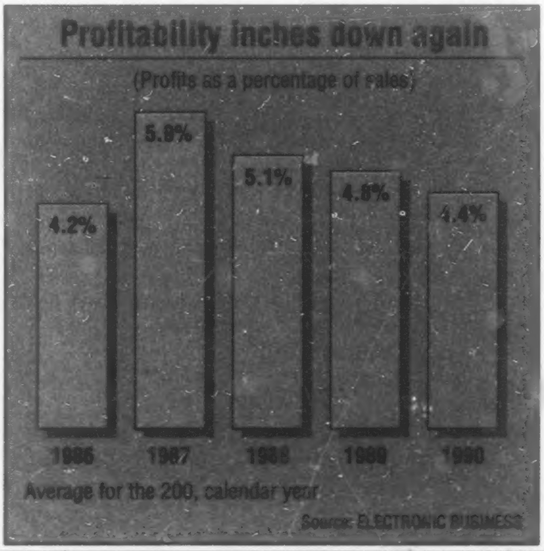
Leading the 1990 list is Microsoft Corp. of Redmond, Wash., whose calendar year profits totaled $355.6 million on sales of $1.48 billion, or 24.1% of sales. Microsoft finally achieved the top ranking after placing third in 1988 and second in 1989. Autodesk Inc. of Sausalito, Calif., and Novell Inc. of Provo, Utah, placed second and third, respectively.

Software vendors have one built-in advantage over hardware manufacturers: With minuscule raw material costs and the ability to replicate their products inexpensively, the software companies can keep cost of sales down and gross profit margins flying. Microsoft's performance in the first quarter of 1991 (the company's third fiscal quarter) is indicative: On revenue of $486.9 million, the company realized a net income of $123.8 million, or 25.4%. Cost of sales was just 19.6% of revenue for the quarter, resulting in a gross profit margin of 80.4%.

"It's tough to hold those margin levels, and we don't predict we'll be able to maintain them," says Buck Ferguson, director of administration and investor relations at Microsoft. However he does expect the company's overall profitability to hold steady in the coming years.

For its part, Novell saw its gross profit margins grow from 71% in early 1990 to 82% a year later. But further improvements may be elusive. "We're approaching the ceiling at 82%," says James R. Tolonen, Novell's chief financial officer.

Despite their cost-of-sales advantage, software companies often incur greater operating expenses than their hardware brethren, Tolonen notes. Distribution costs can be relatively high for software producers, as can research and development expenditures. At Autodesk, operating profit margins have dropped from about 40% of revenue to the 32% to 33% range, largely because the company has been pumping more money into R&D, according to Christine Tsingos, Autodesk's treasurer. That expense will grow slightly this



Source: ELECTRONIC BUSINESS

year, she says, from about 11% of revenue to 12% by year end.

Compaq Computer Corp., by contrast, spent just 5.2% of its revenue on R&D last year. "Because we're part of an industry standard in personal computers, we can leverage Intel's and Microsoft's R&D," explains Daryl J. White, senior vice president of finance and chief financial officer at the Houston company. Thanks to material cost reductions during 1990 (especially in memory chips), Compaq raised its gross profit margin to a healthy 42.8%—slightly more than half that of the software leaders.

ALTHOUGH 1990 WAS a strong year for Compaq, with after-tax earnings 12.6% of sales, 1991 looks less promising. Like other PC manufacturers, Compaq saw earnings decline due to a combination of factors. The strong dollar, for example, hurt foreign sales, and aggressive price cutting made profits harder to come by. In addition, Compaq announced in May that dealer channel restructuring had caused an inventory glut and a consequent drop in new orders.

To counter the strong dollar, Compaq will increase the local content of parts for its PCs built in Scotland. "Materials make up 80% of the cost of goods sold," notes White. He also expects the excess inventory to be corrected by this year's fourth quarter and says the company should still see 3% after-tax earnings for the year.

Last year was not a good one for the overall semiconductor industry, yet two of its San Jose-based members—Intel Corp. and Cypress Semiconductor Corp.—made the top 10 in profitability. Insatiable demand for its 386/486 family of microprocessors kept Intel's profits strong, and that strength continued into the first half of this year, despite the March 1991 availability of 386 chip clones from Advanced Micro Devices Inc. The 386 demand may be great enough to boost profits at both companies: Sunnyvale, Calif.-based AMD, which lost $53.6 million on revenue of $1.1 billion last year, expects to sell about $100 million worth of its 386 clones this year.

Cypress Semiconductor kept profits high by introducing 39 new products in 1990. More than a third of the company's revenue comes from static random access memory products, and late last year Cypress paid $14.5 million for Control Data Corp.'s $60 million fab in Bloomington, Minn. Cypress expects to make the plant the lowest-cost, most competitive SRAM fab in the United States.

The most and least profitable

The top ten	Profits/ sales	200 rank
Microsoft	24.1%	47
Autodesk	23.9	171
Novell	20.8	88
Acuson	16.9	138
Intel	16.6	18
Cadence Design Systems	16.4	176
Cypress Semiconductor	14.8	180
Cray Research	14.0	71
Medtronic	12.7	70
Compaq Computer	12.6	20
Median for the 200	3.8%	
The bottom five		
Wang Laboratories	-24.6%	37
Datapoint	-23.6	148
MAI Systems	-20.9	116
Ultimate	-20.2	197
Concurrent Computer	-20.2	134

Includes only companies with electronics sales over 50% of total

Calendar year — Source: ELECTRONIC BUSINESS

The most improved in profitability

The top ten	Point change	Profits/sales 1990	Profits/sales 1989	200 rank
Control Data	23.4	0.2%	-23.2%	44
Sprague Technologies	23.3	0.7	-22.6	126
Micropolis	18.3	2.1	-16.2	117
Diasonics	17.2	6.1	-11.1	149
M/A-Com	15.2	4.2	-11.0	115
Savin	12.9	0.1	-12.8	130
Kollmorgen	10.0	1.7	-8.3	186
Genicom	9.8	0.4	-9.4	156
Applied Magnetics	8.9	2.3	-6.6	112
Novell	8.5	20.8	12.3	88

Includes only companies with electronics sales over 50% of total

Calendar year — Source: ELECTRONIC BUSINESS

Profits are hard to come by in the medical electronics sector as well, with efforts to control health-care costs putting a squeeze on some companies. Yet Acuson Corp. and pacemaker manufacturer Medtronic Inc. both made the top 10 profitability cut. A manufacturer of ultrasound equipment, Mountain View, Calif.-based Acuson gains from the cost/benefit of that technology compared with other scanning devices such as X-ray and computer-aided tomography (CAT) scan machines, says William Varley, vice president of marketing. The company held profits steady at near 17% for three years and expects to maintain that level.

Also making the top 10 was Cray Research Inc. of Eagan, Minn. A regular among the ELECTRONIC BUSINESS 200's most profitable companies, Cray continued to dominate the supercomputer niche in 1990 while branching out into the minisupercomputer marketplace. ☐

Doing more with less isn't just a slogan anymore

After slumping in 1989, productivity among the top 200 grew 12% last year

By Elizabeth B. Baatz

The U.S. electronics industry has managed its resources more efficiently during the latest economic downturn than ever before. Last year, well over one-quarter of the ELECTRONIC BUSINESS 200 companies reduced their employee ranks while increasing sales at the same time.

Total employment within the 200 companies fell by 2.4%, but total sales rose by 6.3%. As a result, productivity for the ELECTRONIC BUSINESS 200 (as measured by sales per employee) jumped 12% between fiscal 1989 and 1990, to reach an average of $150,010.

The prior year, productivity had inched up just 4%—actually a decline when inflation is factored in. With signs of a recession in the wind, electronics companies in the United States worried whether they could compete if productivity was on the downswing. The question was particularly troublesome because the 1986 recession had slashed productivity by 7.6%, despite a 13.9% cutback in ELECTRONIC BUSINESS 200 employment. As a result, the bottom line took it on the chin. Many observers last year feared that the productivity decline in 1990 would be as bad as in 1986.

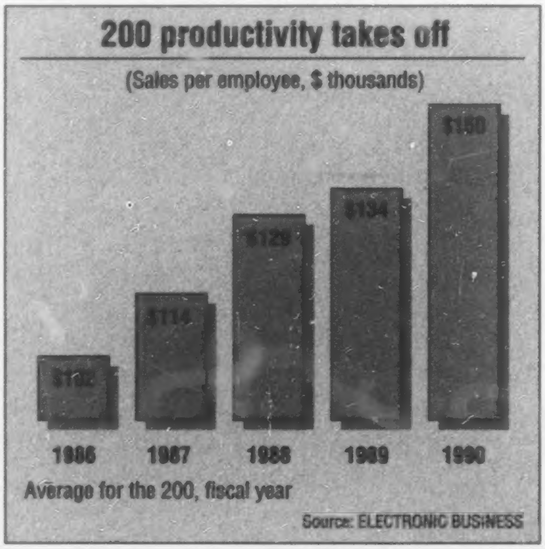
But this time around, the productivity slump simply did not last, as sales per employee for the 200 rose a satisfying 12%. If the industry can maintain that kind of stellar performance this year and next, perhaps total quality management and the years of mergers and restructuring will finally pay off.

Indeed, the investment in productivity improvements has helped Dallas-based BancTec Inc., #200 on this year's ELECTRONIC BUSINESS 200 list. BancTec managed to reduce head count by 163 employees (8% of its work force) in fiscal 1990, while at the same time growing sales 4%. Sales per employee rose from $63,300 in 1989 to $104,000 in 1990, making BancTec the most improved company in terms of productivity on this year's list.

How did BancTec do it? According to chief financial officer G. Wesley Mayland, the company's judicious acquisition of Computer Entry Systems Corp. in January 1989 helped the numbers a great deal. "CES was three-quarters as large as BancTec," says Mayland, "so our revenue jumped. At the same time, we wiped out their overhead, got rid of a level of management, and saved money by removing duplicate field-service positions."

BUT A GOOD MERGER wasn't all that helped BancTec improve its numbers. BancTec has spent about $3 million in the past few years to improve its own technology, according to Mayland. As a company that sells labor-saving document readers to banks and financial institutions, BancTec knows the value of investing in productivity-enhancing technology. Electronic messaging, telemarketing tools, and other office equipment now help BancTec do more with less.

Disk-drive maker Quantum Corp. also makes the top ranks of productivity. The Milpitas, Calif., company (#77 on the list) sold $584,900 worth of products for every employee on its payroll last year. Only two other electronics companies in the 200 were more productive—consumer-electronics marketer Emerson Radio Corp.—with sales per employee of $800,200—and distributor Anthem Electronics Inc.—with sales per



200 productivity takes off

(Sales per employee, $ thousands)

Average for the 200, fiscal year

Source: ELECTRONIC BUSINESS

employee of $701,300.

One reason that Quantum produces such high sales per employee is its manufacturing relationship with Japan's Matsushita Kotobuki Electronics, which makes about 90% of Quantum's products. The best way to join the ranking of most productive companies is to contract out all the labor-intensive work such as manufacturing—hence the addition of fabless semiconductor maker Chips and Technologies and four distributors to the top 10 most productive list.

What makes Quantum so special is not just that it ranks high in the *level* of productivity, but that the company also *improved* productivity by 49% last year. That placed Quantum in the #5 position on the list of most improved companies in terms of productivity. Quantum also was the only company among the top 10 most-improved companies that managed to raise productivity while increasing employment. The company's payroll rose 44% in fiscal 1990 while sales rose a whopping 266%. Back in 1987, Quantum's sales per employees stood at just $176,000.

Perhaps total quality management and the years of mergers and restructuring will finally pay off

According to Quantum's executive vice president of finance, Joe Rodgers, the manufacturing relationship with Matsushita Kotobuki has yielded dividends in productivity back at Quantum's own manufacturing plant in the United States. "We learned a lot from MKE—how to design product for automation and how to build it using robots," Rodgers says. "As a result, we've reduced scrap and other errors due to human handling, we have improved first-time-through yields, and, of course, we have reduced direct labor costs."

Clearly a merger that allows one to cut duplicate overhead while increasing sales and investment in labor-saving equipment can improve a company's productivity. But Anthem president Peyton Gannaway tells a simple story. When asked why his company, with sales per employee of $701,300, yields over $275,000 more than the next most productive electronics distributor, Gannaway says simply, "We just work harder."

The most improved in productivity

The top ten	% change	Sales/ employee	200 rank
BancTec	64.2%	$104,000	200
Esterline	63.7	100,600	170
Recognition Equipment	53.5	152,200	189
Anacomp	50.8	130,400	183
Quantum	49.3	584,900	77
Harris	44.9	91,400	25
Concurrent Computer	44.6	123,700	134
Kollmorgen	42.4	95,400	186
M/A-Com	34.9	78,700	115
Micropolis	31.1	126,000	117

% change in 1990 from prior year

Fiscal year Source: ELECTRONIC BUSINESS

The most and least productive

The top ten	Sales/ employee	200 rank
Emerson Radio	$800,200	76
Anthem Electronics	701,300	111
Quantum	584,900	77
Audiovox	446,600	141
Chips and Technologies	441,200	147
Arrow Electronics	425,900	65
Apple Computer	382,600	13
Pioneer-Standard	371,100	121
Tandon	365,200	107
Marshall Industries	341,900	85
Median for the 200	$124,000	
The bottom five		
Applied Magnetics	$31,500	112
CTS	45,300	158
National Semiconductor	51,200	43
Zenith Electronics	52,200	48
Vishay Intertechnology	53,600	100

Includes only companies with electronics sales over 50% of total

Fiscal year Source: ELECTRONIC BUSINESS

"Working harder. Working smarter. Doing more with less. Every man and woman in corporate America has heard these slogans. But Anthem seems to have incorporated these slogans into its very culture. Says Gannaway, "We try to create the most productive people through extensive training and hiring. Our intensive quality program produces people that are more able and better motivated." At Anthem, the push for productivity comes from the top as management focuses on the most productive activities. "We have a strong application of the 80/20 rule," says Gannaway. "We identify those 20% of the activities that produce 80% of the results and avoid those activities that don't produce results."

That theory sounds good, but the challenge is in the execution. For the electronics companies that are still struggling to improve productivity and compete in the worldwide marketplace, that challenge has never been more critical than today. ☐

THE ELECTRONIC BUSINESS

200

High tech chips away at its high debt

But analysts still warn that any debt in the volatile electronics industry may be too much

By Rick Whiting

After growing rapidly through 1988 and 1989, average corporate debt among U.S. electronics companies showed signs of leveling off in 1990. But while Compaq Computer Corp. in Houston and others paid off large blocks of debt last year, many continued to wrestle with the huge burdens they had accumulated in earlier years.

Within the ELECTRONIC BUSINESS 200, the weighted average debt as a percentage of total capital increased to 53.2% in 1990, up from 49.1% a year earlier. That continues a disturbing trend that began in 1988 when debt burden skyrocketed to 45.3%. Between 1983 and 1987, debt as a percentage of capital had averaged 26.9% for the top 200. These statistics include auto makers and companies with financial service and credit operations, which skews the debt picture.

On the other hand, among the companies in the top 200 where electronics products account for 50% or more of sales, things are much brighter; the ratio of average debt to total capital stood at 31.1% last year, down a fraction from 31.7% in 1989.

"That's certainly manageable," says Katherine Kirk, managing director of Hambrecht & Quist in Boston. She puts the red line for debt ratios at around 40%.

The median debt-to-capital ratio is showing signs of turning around among those ELECTRONIC BUSINESS 200 companies. This ratio fell to 22.9% in 1990 from 24.7% in 1988 and 1989, and 20% in 1987.

Given the industry's cyclical boom-or-bust nature, electronics is a tough business for companies that carry heavy debt loads. While sales of potato chips or cereals may change little through good times or bad, sales of computers and other electronics goods are more closely tied to swings in the economy, making debt financing a risky proposition.

"This is a fast-changing industry," notes Dick Frucci, a senior vice president with the Boston-based Putnam Management Co. His argument: Companies that are taking technological risks should not be taking financial risks. "The less debt on the balance sheet, the better."

Heavy debt burdens could also be dangerous for companies that sell into highly competitive markets—PCs, for example—where profit margins are razor thin. High debt payments are a fixed cost that vendors in such markets would rather do without.

CONSUMER ELECTRONICS manufacturers, whose average debt ratio spiraled upward from 25.9% in 1989 to 38.4% last year, recorded the greatest debt increase among all industry segments in 1990. Tandy Corp. in Fort Worth increased its ratio from 15.7% in 1989 to 35.5% last year by borrowing heavily to finance inventory increases, to buy back its own stock, and to acquire Victor Microcomputer of Sweden. North Bergen, N.J.-based Emerson Radio Corp.'s short-term borrowings to build up inventory pushed its ratio up from 57.6% in 1989 to 69.7% in 1990.

Meanwhile, makers of desktop computer systems cut their average debt ratio nearly in half, from 22% in 1989 to 11.6% in 1990. Prudential-Bache Securities analyst Rick Martin attributes the drop to several PC companies (including Compaq and AST Research) converting large chunks of debt into stock during the year.

Most industry segments showed little change from 1989 to 1990. Among communications equipment vendors, debt inched up from 28.8% of total capital to 29.3%; for distributors it

The largest debtors

The top ten	Debt to capital	200 rank
[illegible]	126.3%	152
[illegible]	100.1	185
[illegible]	89.1	130
International Rectifier	87.2	164
MAI Systems	72.5	116
Emerson Radio	69.7	76
[illegible] Equipment	68.1	189
[illegible]	67.9	170
[illegible]	67.4	158
[illegible]	67.2	150

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The biggest debt decreasers

The top five	Point change	Debt to capital 1990	Debt to capital 1989	200 rank
Litton Industries	-38.4	18.0%	56.4%	24
Conner Peripherals	-32.9	6.3	39.2	51
AST Research	-28.9	14.0	42.9	82
Storage Technology	-24.6	28.8	53.4	58
Silicon Graphics	-22.7	13.7	36.4	96

Fiscal year. Source: ELECTRONIC BUSINESS

The biggest debt increasers

The top five	Point change	Debt to capital 1990	Debt to capital 1989	200 rank
Smith Corona	47.0	51.3%	4.3%	123
Archive	46.2	58.4	12.2	122
Tandy	19.8	35.5	15.7	15
MAI Systems	19.3	83.8	64.5	116
Arrow Electronics	15.1	58.4	43.3	65

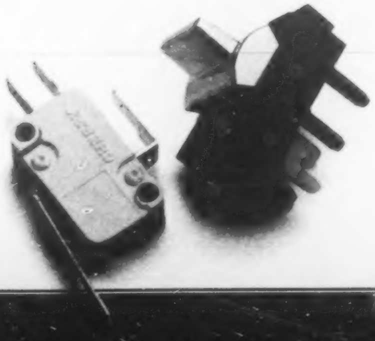
Fiscal year. Source: ELECTRONIC BUSINESS

decreased from 27.2% to 25.9%; and semiconductor manufacturers' debt held steady at 23.7%.

Mergers and acquisitions, a major culprit behind the debt increases of recent years, slowed in 1990. But the hangover persists. Despite efforts by executives to reduce debt load, Unisys Corp. in Blue Bell, Pa., was still burdened by a 51.7% debt ratio last year, the legacy of its creation through the merger of Sperry and Burroughs in 1986. Encore Computer Corp. in Fort Lauderdale, Fla., had one of the highest debt ratios in the ELECTRONIC BUSINESS 200 as a result of its borrowings for the April 1989 acquisition of Gould Inc.'s computer systems division.

Nevertheless, Frucci believes that the overall trend is toward a lowering of debt ratios among electronics companies, that increased competition is forcing executives to manage their businesses more efficiently, and that the same motivations for instituting just-in-time manufacturing and other competitive strategies are leading to more conservative financing practices. ☐

Cherry.
The switch company.



THE BIGGEST RISE

THE ELECTRONIC BUSINESS

200

Archive buys its way to revenue growth

The challenge now is to fight off tape-drive competitors while shedding debt from last year's buyout of Cipher Data Products

By David Webb

In the winter of 1989-90, two major U.S. data tape drive manufacturers, longtime rivals in the hotly competitive data backup market, squared off in a bitter takeover battle. It was the final face-off in what one industry analyst described at the time as "a bloody war."

Costa Mesa, Calif.-based Archive Corp., then a $181 million company flush with cash and the momentum of marketplace success, emerged as the victor in April 1990. Its embattled archrival, Cipher Data Products Inc. of San Diego, eventually succumbed to Archive's $130 million buyout siege.

The takeover nearly doubled Archive's size, turning it into a $293 million company and the world's largest independent vendor of data tape drives. The acquisition also helped Archive rise farther in the ELECTRONIC BUSINESS 200 than any other company on this year's list—64 slots, from #186 to #122. Cipher gave Archive not only new product lines and increased manufacturing capability, but also new customers—most notably IBM (a $120 million customer at the time) and Compaq Computer Corp. (then worth $66 million in business).

Before the Cipher acquisition, Archive was essentially a quarter-inch cartridge (QIC) tape drive manufacturer that targeted the desktop and midrange systems markets for hard-disk storage backup with QIC and half-inch cartridge tape drives. Today, it sells a gamut of tape storage products through five business units—two Cipher acquisitions and an earlier acquisition—allowing Archive to market nearly every type of mass-market tape drive.

The acquisition not only eliminated a competitor from the combined $2 billion worldwide markets for digital audio tape (DAT), QIC, and half-inch cartridge drives, but also gave Archive new ready-made distribution and OEM marketing channels. Through Cipher, Archive picked up Irwin Magnetic Systems Inc. and its very profitable quarter-inch minicartridge drive business. Irwin dominated the low-end PC backup storage market over Archive's own minicartridge line. Archive also acquired leading-edge half-inch tape cartridge drive technology in the form of a hot new desktop 3480 cartridge drive that Cipher developed to rescue itself from a proprietary-format whirlpool of doom.

Now Archive is ready to steamroll over the rest of the pack, according to chairman, CEO, and president Howard Lewis. The company's Ardat unit is eating up market share in the fast-growing worldwide market for DAT drives, nudging out Hewlett-Packard for the lead. Analysts expect Archive to stay in the lead a while, though Wangtek Inc. and Wangdat Inc. wield formidable strength in new products. But while HP has lost some ground in the DAT market, it is still a force to be reckoned with—not to mention members of a long list of Japanese and Asian vendors. Topping that list is Sony, followed by Toshiba America, Hitachi, and Sharp.

Founded in 1980 and publicly held since 1985, Archive produces a

Archive at a glance

Fiscal year ended Sept. 28	1990	1989
Sales (thousands)	$293,234	$181,409
Net income (thousands)	$11,537	$15,320
Net income/sales	3.9%	8.4%
Cost of sales/sales	59.2%	62.3%
R&D/sales	7.6%	6.8%
Marketing, G&A/sales	20.0%	16.2%
Number of employees	3,367	1,735
Sales per employee	$87,091	$104,559
Net income per employee	$3,426	$8,830
Capital expenditures/sales	7.2%	7.0%
Current ratio	2.15	2.40
Debt/equity ratio	1.40	0.13
Foreign sales/sales	27.7%	28.0%
Six months ended Mar. 29	1991	1990
Sales (thousands)	$179,506	$99,087
Net income (thousands)	$1,898	$7,508

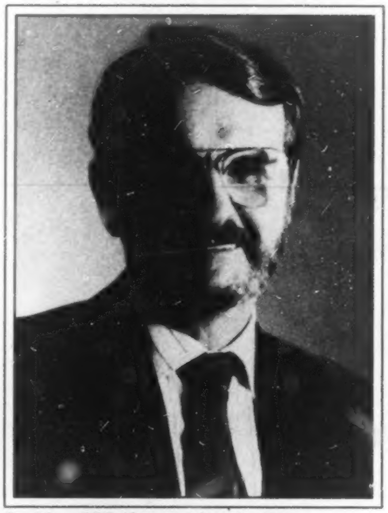
Source: Company reports

broad line of tape drives, tape subsystems, and backup software for computer data backup storage applications. The Cipher buyout (and the acquisition of Maynard Electronics Inc., a Casselberry, Fla.-based maker of storage subsystems, for $20 million in early 1989) was driven by Archive's need to fend off increasingly well-heeled offshore competitors in high-capacity tape storage.

COMPETITION AT HOME was heating up too. Rexon Inc. purchased two companies that bolstered their position in both OEM and distribution channel markets for tape drives. Rexon acquired QIC tape drive maker Wangtek and Tecmar, a subsystem manufacturer that competed with Maynard. The buyout enhanced Wangtek's channel presence and provided additional financial resources. Meanwhile, Cipher was building strength through its acquisition of Irwin, and even IBM was rumored to be testing the waters for high-end desktop storage with an undeveloped DAT drive.

But Archive has paid dearly for Cipher. Wall Street has looked disapprovingly on the company's stock since last fall, at least in part because the acquisition included the assumption of Cipher's own burden of debt. Optimem Inc., a wholly-owned WORM (write-once, read-many) optical disc drive subsidiary, was bleeding Cipher of cash with no hope of delivering a competitive product. (Archive wrote down and jettisoned the unit this year but retained service for Optimem's customers.) Cipher was also spending millions to battle competitors—mostly Archive—in court over patent disputes, none of which were fully resolved before Archive's hostile takeover.

"We acquired a company with some significant problems," says Archive CFO B. J. Rone, "and we never tried to paint a picture of [the buyout] as a one-year turnaround. The real advantages of the acquisition is a two- to three-year event."



Archive CEO Howard Lewis: The company must do "an exceptional job" of securing its data-backup business

CEO Lewis also concedes the acquisition hasn't been easy. "In some respects, it's been smooth and [in others] difficult," he says. "We took care of all the real bad news at once, and that resulted from a lot of front-end planning. Within the first couple of weeks we had structured the [combined] company the way we wanted to." Nevertheless, he adds, integrating the new business into Archive's standard operations has been difficult.

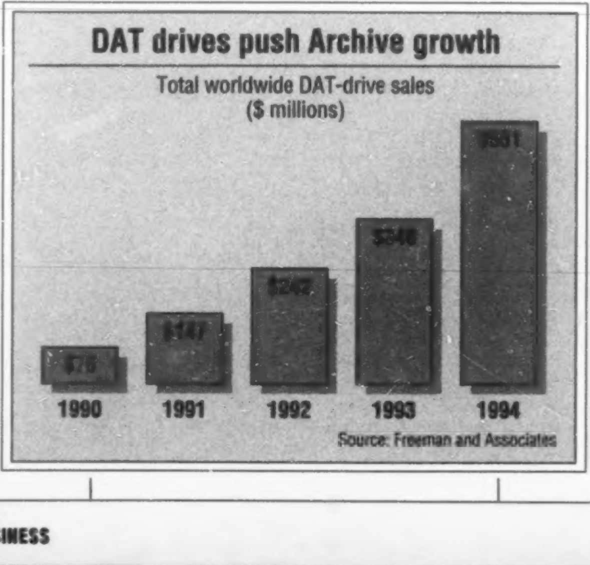
Meanwhile, business for low-end 80- to 120-Mbyte QIC drives is falling off sooner than expected because of the recession and slower PC sales. QIC drive sales are still the company's largest revenue contributor, according to Lewis, but DAT is expected to eventually wipe out demand for QIC drives because of falling prices. Volume pricing for 1.3-Gbyte DAT drives have dropped below $1,000, making the devices more attractive to users on a cost-per-megabyte basis.

But the market for QIC drives is far from dead. Archive and Wangtek each have shovelled out 1.3-Gbyte DC-600 class QIC drives, and 500-Mbyte DC-2000 minicartridges are now in the market. "There is still room at the low end for quarter-inch, especially in the minicartridge [market]," says Bob Abraham, vice president of the Santa Barbara, Calif., market research firm Freeman Associates.

Moreover, Archive is using DAT drives as building blocks for cheap, very high capacity multiple-gigabyte automated DAT cartridge libraries (commonly known as "stackers") for network and large system storage backup. "I believe that growth in business in backup will be near 25%," Lewis says. "We're going to have to do an exceptional job in taking advantage of high-capacity demands."

The challenge in the meantime is to accomplish that while bringing down the debt burden acquired from Cipher. Rone says the company will pay off a $120 million loan before the four-year payback period is up; nearly half of a $40 million revolving loan has been paid. The company has ramped up production of its latest-generation 3.5-inch form factor DAT drives and is readying production of a 1.3-Gbyte QIC drive for the fall. Both products are seen as essential to sustaining Archive's momentum. ☐

DAT drives push Archive growth



Source: Freeman and Associates

THE BIGGEST FALL

THE ELECTRONIC BUSINESS
200

Recognition Equipment rebuilds itself—and its reputation

The company dropped 30 places on this year's ELECTRONIC BUSINESS 200, but it is now drawing kudos for a brand-new strategy

By Peter Burrows

There's nothing good about a federal fraud investigation that leads to the resignation of your CEO, class action suits, a temporary ban on doing business with the government, at least $450,000 in legal fees, and an unsavory reputation with existing and would-be customers. Or is there?

Thomas M. Hurley, co-CEO of Dallas-based Recognition Equipment Inc., would know. He claims that federal bid-rigging allegations against his predecessor and the company itself cost REI more than $100 million in lost business, legal fees, and settlements since the indictments came down in October 1988. But he also says that the company would not have been able to make the sweeping changes of the past year if the pressure had not forced out the company's former management team (both of whom were acquitted last November).

"We tried to look at it as an opportunity," says Hurley, who took the reins with partner Robert Vanourek in October 1989. The pair, with the backing of The Prospect Group, a New York investment firm, previously made two unsuccessful hostile bids for the company after the indictments were brought; intense trial-related pressures and shareholder lawsuits finally compelled the board to submit. "The investigation created a power vacuum, and we came in to fill it," says Hurley.

Since then, Hurley and Vanourek have moved quickly to remake the 29-year-old company in their own image. Their decision to reposition and downsize REI has produced some hefty write-offs and huge headaches for the short term, including a $31 million loss in 1990 and a fall from #159 on the ELECTRONIC BUSINESS 200 to #189—the biggest drop of any company in this year's ranking. But the new management team says the pain was inevitable. For although REI had earned a reputation for technical innovation for its proprietary, stand-alone document-handling and data/image-recognition equipment, big losses in 1988 and 1989 indicated the old strategies were not working. Indeed, the company took annual losses four times during the 1980s, for a net loss of $26 million for the decade.

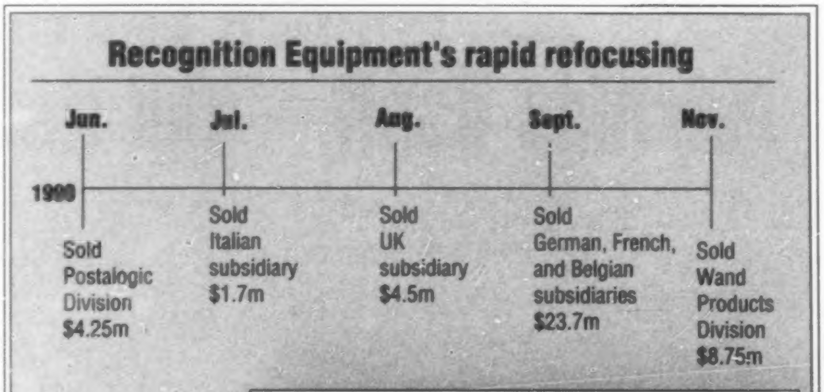
WITHIN WEEKS OF taking charge, Hurley and Vanourek decided to refocus the company entirely on the document image-processing business. This emerging industry—which is expected to grow from $890 million in 1990 to $5.7 billion in 1994, according to New York-based Frost & Sullivan—is being driven by large computer companies and system integrators, who combine hardware such as scanners and optical readers with software for customers in search of an automated means of data entry and paper processing. Rather than sell directly to end users, the new strategy is designed to ride the shoulders of these large system vendors by having them sell REI equipment as part of their integrated offerings.

Much of the required restructuring was done in 1990. All of the former managers—except the

Recognition Equipment at a glance

Fiscal year ended Oct. 31	1990	1989
Sales (thousands)	$230,618	$255,874
Net income (thousands)	-$31,687	-$38,803
Net income/sales	-13.7%	-15.2%
Cost of sales/sales	64.8%	63.8%
R&D/sales	4.3%	2.5%
Marketing, G&A/sales	29.1%	31.7%
Number of employees	1,515	2,540
Sales per employee	$152,223	$100,738
Net income per employee	-$20,916	-$15,277
Capital expenditures/sales	1.4%	1.9%
Current ratio	2.04	1.63
Debt/equity ratio	2.13	1.15
Foreign sales/sales	57.9%	57.7%
Six months ended Apr. 30	1991	1990
Sales (thousands)	$74,473	$116,323
Net income (thousands)	$3,673	-$12,989

Source: Company reports



Recognition Equipment's rapid refocusing

Source: Company reports

Co-CEOs Tom Hurley (left) and Bob Vanourek have wasted little time refocusing the company after federal fraud indictments chased REI's former management in 1989

general counsel—were replaced. Three business units that were deemed outside the document-imaging rubric, as well as five foreign subsidiaries that had been used primarily as direct-sales offices, were sold. The remaining head count was reduced by 25%. The result was a 30% reduction in assets (from $240 million to $170 million) and a 40% cut in head count (from 2,540 employees to 1,515).

The company also has moved to build on the former management's 1989 purchase of Plexus Computer Inc., a bankrupt software company whose application development tools are regarded as a standard in the document-imaging world. Since many system vendors use Plexus software to develop their own document-image processing applications, analysts say the purchase was a savvy way to carve a door into this rapidly developing marketplace. The move already has helped REI reach various partnering agreements with system vendors such as Amdahl, Andersen Consulting, AT&T, Data General, Hewlett-Packard, NCR, Sun Microsystems, TRW, Unisys, and Wang Laboratories.

THE PLEXUS acquisition has another key advantage. Because the software is hardware-independent and features extensive networking, the integration of REI's formerly proprietary equipment with Plexus software has provided a more open architecture, allowing the equipment to work with many popular commercial hardware platforms. Hurley admits the company has far to go to change its hardware-based corporate culture, but all indications are that REI is trying to fall into step with the trend toward open systems.

Hurley says the company's recovery is on track. The goal for 1991, he says, is a return to profitability, and the company has managed to make a meager profit of $3.7 million through the first half of their fiscal year. He also points to the 54% gain in productivity per employee between 1989 and 1990—the second best on this year's EB 200—and says the company has eliminated four management levels from its traditional eight-tier structure. "We've bitten the bullet," says chairman Gilbert H. Lamphere, whose full-time job is chairman of The Prospect Group, which recently sold its 20% stake in the company. "This is the year to look for profits."

But many observers are growing impatient. The profits of the first two quarters have been due more to asset sales than to operating income, productivity gains are largely a result of the slashed head count, and few of the new-look products have actually come to market. "Stating a corporate objective is fine, but it's easier said than done," according to Jane Stanhope, an analyst with BIS Strategic Decisions in Norwell, Mass.

And the company has not quite shed the unsavory reputation that comes with being tied up in federal fraud investigations, which, in this case, focused on a complex bid-rigging scheme to land a $400 million contract with the U.S. Postal Service. Launched in 1985, the investigation resulted in the conviction of two public relations consultants and a former vice chairman of the Postal Board of Governors, who handed out bribes and kickbacks in an attempt to land the contract. REI and the two indicted former executives were ultimately acquitted as unwitting victims of this scheme.

But REI's reputation has suffered despite the acquittals. "Most citizens do not think the government goes around indicting innocent people," says Hurley. "So we have to prove to them that we are still the company they once knew and loved. You just can't escape your reputation." □

THE ELECTRONIC BUSINESS

200

Up-and-comers for 1991

Some companies that just missed this year's ELECTRONIC BUSINESS 200 will be strong contenders the next time around

By Barbara Jorgensen

It's nearly impossible to list the top 200 U.S. electronics companies without wondering about the ones that *almost* made it.

We counted 21 such companies this year. With revenue between $162 million and $187 million, their exclusion in no way suggests poor performance. In fact, only 3—Digital Communications Associates, GenRad Inc., and Dynascan Corp.—saw sales decline from calendar 1989. But controller manufacturer MagneTek Inc. increased electronics revenue 55.5% and business equipment maker EMC Corp. enjoyed a 29.4% rise, while sales for The Cherry Corp. and Rexon Inc. climbed over 20%.

So why didn't those companies make the cut this year? The reason is that the price of admission has gone up. While the collective weight of all the 200 grew by 6%, the cut-off point for the #200 company grew 17% from calendar 1989 to 1990. If this trend continues, the #200 company will need at least $220 million in electronics sales to make the list next year.

This year's near-miss (#201) is PC communications company Digital Communications Associates, which ranked #174 on last year's 200 list. DCA, explains president Garry Betty, began a painful reexamination of its business with the sale of its wide-area network division (its premier business) in December 1989.

"We invested heavily in our [WAN] business at the expense of our PC-communications products," says Betty. Meeting customer needs, he says, was something DCA had forgotten as it turned inward and examined its own needs. But through a variety of new product introductions, product upgrades, and forums for interacting with customers, projections for fiscal '91 look good. As for the #201 spot, Betty jokes: "We should have sold another $3 million in equipment." But, he warns, don't discount DCA for next year.

The next 21 companies

Rank	Company	Electronics sales ($ millions)
201	**Digital Communications**	$187
202	**MagneTek**	185
203	**Harnischfeger Industries**	184
204	**Legent**	181
205	**GenRad**	179
206	**Exide Electronics**	178
207	**Burr-Brown**	177
208	**SynOptics Communications**	176
209	**LTX**	173
210	**Cherry**	173
211	**EMC**	171
212	**Exabyte**	170
213	**Rexon**	170
214	**Telxon**	169
215	**Dynascan**	169
216	**Adobe Systems**	169
217	**Intermec**	168
218	**Brown & Sharpe**	166
219	**Network Systems**	164
220	**Richardson Electronics**	163
221	**MTS Systems**	162

Calendar year 1990 Source: ELECTRONIC BUSINESS

Another strong candidate for next year's 200 is Exabyte Corp., whose 1990 revenue of $170 million was nearly double the $89 million in 1989. "I'd be surprised if we didn't make next year's list," says CEO Peter Behrendt. Exabyte has adapted a consumer technology for its now-booming 8mm cartridge tape data-storage subsystem business and counts IBM, Sun Microsystems, Siemens, and Groupe Bull among its customers.

LTX Corp., which along with GenRad has been struggling through difficult years in the board- and chip-test businesses, made a comeback of sorts. Sales in calendar 1990 rose 47% over the previous year. The company last made the 200 in 1988. LTX's manager of investor relations, R. Scott Higgins, says, "1989 was a tough year for us. We hit bottom." The company's turnaround strategy consists of maximizing opportunities in digital logic test, improving its performance in the Far East, and capitalizing on its Synchromaster mixed-signal-chip test system. Financial indications so far look good, says Higgins, and Wall Street projects that LTX will end fiscal 1991 in July between $190 million and $200 million. Unfortunately for LTX, that most likely means they'll be missing from next year's ELECTRONIC BUSINESS 200 as well. □

R&D dog days
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Battle for X terminals
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Tektronix looks ahead
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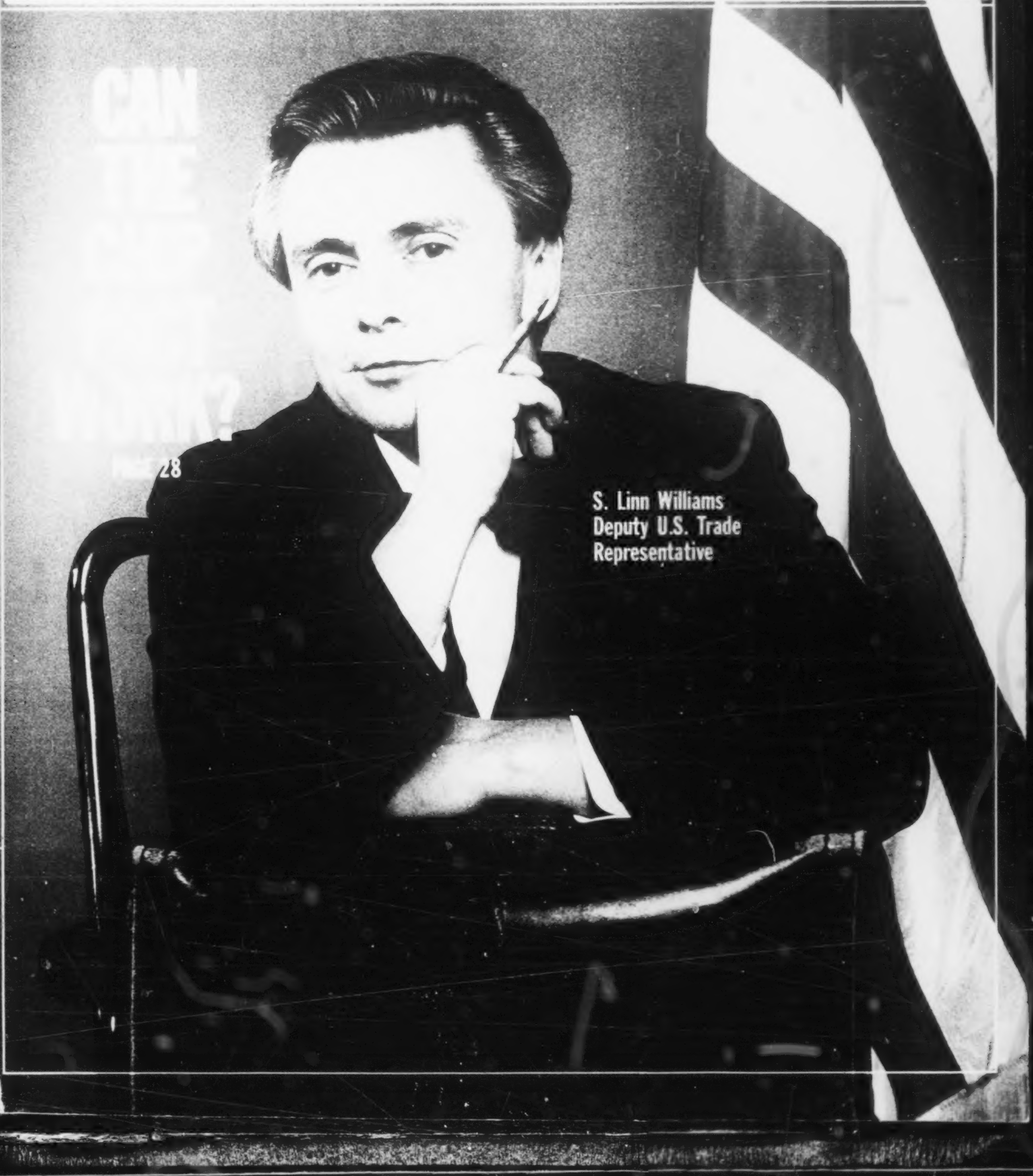

CAN [illegible] WORK?

PAGE 28

S. Linn Williams
Deputy U.S. Trade
Representative

Electronic Business

VOLUME 17, NUMBER 15

FOR THE MANAGEMENT TEAM IN ELECTRONICS, COMPUTER, AND SYSTEMS COMPANIES WORLDWIDE

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Cover photo by Patricia Fisher

COVER STORY

28 New chip pact promises wider door to Japan

The trade agreement between the United States and Japan may not have been made in heaven, but both sides have compelling reasons to make it work

The new semiconductor agreement isn't about market share, argues deputy USTR S. Linn Williams, but about creating good business relationships

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Business Trends

9 Failures in electronics are way, way up; HP huddles up on the open-systems playing field; Korea sets its sights on the IC equipment market; the Japanese buy out the Finns, courtesy of the Brits; molecular chip design is on the way; the incredible shrinking disk drive; Intel looks to modules; VHDL picks up steam

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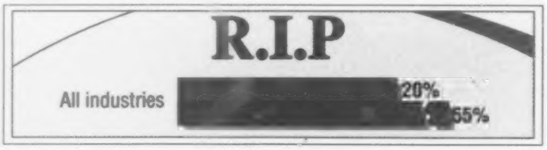

PAGE 9 Business failures are on the rise for all industries, including electronics

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Growth slows, earnings suffer at top U.S. and European electronics companies in Japan

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INSIDE BUSINESS

Chipping away at the trade agreement

Associate art director Elizabeth Zisa

PERSISTENCE pays off. If, like Aesop, we could end every story with a moral, that's how we'd wrap up Valerie Rice's analysis of the new five-year trade agreement between U.S. and Japanese chip makers.

And what persistence. For the past four years, despite a standing agreement between the semiconductor industries of both nations, there had been disagreement, if not outright animosity, on all fronts. The new five-year accord finally meets a number of key U.S. objectives.

Not that the new trade agreement is perfect. While the new agreement (unlike the old one) specifically mentions a 20% share of the Japanese chip market for foreign manufacturers, that figure is just a target, not a guarantee. But putting that target in plain view is surely progress.

The other crucial aspect of the new agreement has to do with market access and increasing design-in and partnering between U.S. and Japanese companies in specific market segments. That's a big step forward from the days when *keiretsu* was a dirty word for anyone trying to land a purchase order in Japan.

Analysts agree that a key difference in this round of semiconductor trade talks was the willingness of the U.S. to take a decisive role. Will the Bush administration have the persistence to enforce the new agreement? That's one critical question. Another is if U.S. semiconductor companies will take advantage of new market opportunities in Japan. There will be far fewer excuses this time around.

Written analysis of important developments like the chip-trade agreement is a big part of this magazine's job. But the graphical element is also important, and in some cases the graphics *are* the story. Our report on top R&D spenders in this issue is a case in point. Since you won't find a staff byline on our charts, graphs, and illustrations, we'll take this opportunity to introduce our new graphics designer, associate art director Elizabeth Zisa.

Elizabeth is new to ELECTRONIC BUSINESS—this is her third issue—but she has been with Cahners for nearly five years. Working with art director Mike Roach, Elizabeth lays out features and departments and helps assign and collect much of the artwork, often under heavy deadline pressure. The most satisfying part of the job? "When the art and the editorial come together—and it really works."

—By John Parker

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ECONOMICS

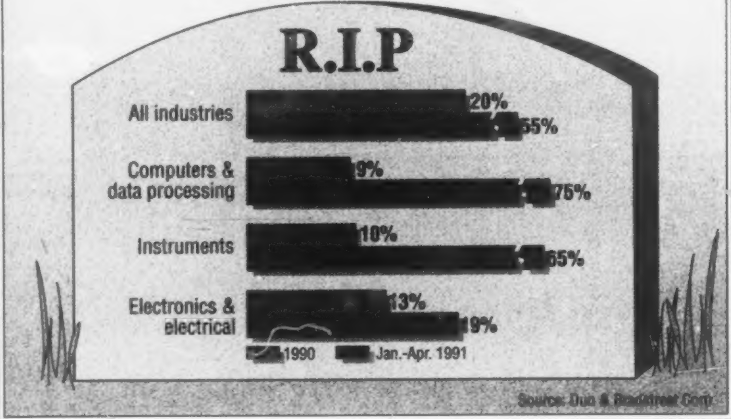
Failures in electronics are way, way up

OK. SO THIS HAS BEEN a *mild* recession. Tell that to the 416 computer, electronics, instruments, and research and testing service companies that shut their doors in the first four months of 1991. That's 50% higher than the number of failures during the same period a year ago, and much higher than the 10% rise in electronics failures between 1989 and 1990.

"The electronics industry has been given a strong dose of survival-of-the-fittest medicine lately," says Maddy Franchi, senior economist with Cahners Economics in Newton, Mass. The computer and data processing equipment makers have had the worst time. With 185 companies filing for bankruptcy or Chapter 11, failures rose 75% in the first four months of 1991. At that rate, over 555 computer and related companies could be out of business by year-end, compared with 371 companies the year before.

Business death knell grows louder

(% increase in number of failed companies)



Source: Dun & Bradstreet Corp.

The explosion of business failures has hit all industries. According to The Dun & Bradstreet Corp., which tracks failures across the United States, all business failures jumped 55% in early 1991 compared with a year ago. Says D&B's Reid H. Gearhart, "Although the '80s showed a long and sustained expansion, much of the Midwest was actually pretty weak due to the rolling recessions, first in petroleum and then agriculture. The recession in the Northeast has now sent failures through the roof, with the jump in failures spilling over lately into the Middle Atlantic states."

Two traditional high-tech bastions were hit particularly hard, reports D&B. Bankruptcies in the New England states were up 108% to 466 in April 1991 from 224 in April 1990. "The Pacific region—which was one of the star regions during the economics expansion—is continuing to show signs of stress," says Gearhart. "Business failures increased 85.4% in April to 1,485, with California posting a 69.5% increase."

Even as indicators point toward a recovery, don't look for an immediate improvement in the rate of business closures. "Increasing business failures tend to be a lagging economic indicator, so I would anticipate the trend to continue before we see the benefits of the expected economic recovery," says D&B economist Doug Handler. It could be another six months to a year before the pace begins to change. "The economic upturn will not be enough," he warns. "It's a case of too little too late for quite a few companies."

In the electronics industry, he notes, there are some causes for optimism; capital spending is on the upswing, for example. But in spite of the ongoing success in electronics innovation—new-generation computers, chips, and so forth—Handler notes that prices haven't kept up with that pace. "And that doesn't translate into revenue," he adds.

Without a strong economic recovery (which most experts agree is unlikely), those companies on the brink cannot count on relief in the near future. Unlike Chrysler or Wang Laboratories, there is no white knight waiting to help the slew of small electronics companies that are bleeding red ink and are headed for Chapter 11 this year.

—By Elizabeth B. Baatz

COMPUTER SYSTEMS

HP huddles up on the open-systems playing field

IN THE MIDST of alliance-forging and open-systems maneuvering between computer hardware and software vendors, Hewlett-Packard Co. has been quietly working in the background all by itself. And with its June release of the high-power, low-cost HP 3000 and 9000 commercial-market systems, the company is now positioned to compete across the board with the best price/performance offerings from IBM, DEC, AT&T/NCR, and Fujitsu.

"We want to be the No. 2 company next to IBM" in the computer industry, says Bernard Guidon, general manager of HP's General Systems Division. With that kind of ambition, it may behoove the rest of the hudbook" or handheld PCs, particularly the emerging pen-based systems.

At least one other start-up, MiniStor Peripherals of San Jose, is gearing up with a 1.8-inch design; other suppliers of larger form-factor disk drives (namely Seagate, Conner, and IBM) are thought to have 1.8-inch design efforts underway. MiniStor CEO Alex Malaccorto says that Integral has a 20-Mbyte drive that won't get much interest from the notebook vendors MiniStor intends to target, while MiniStor's first product will be a "more than 50-Mbyte" design geared primarily to notebook computers.

According to analysts at International Data Corp., vendors next year should ship about 50,000 1.8-inch drives. IDC predicts shipments of 350,000 in 1993 and 1.7 million by the end of 1994.

—Dave Webb in San Jose

CHIP MODULES

Intel looks to modules to add value

ONE OF THE fastest-growing segments of the memory chip and microprocessor business, multichip modules allow chip makers to integrate several chips in a single package to save circuit board space or reduce design time. More than half of all 4-Mbit DRAMs—the up-and-coming generation—will be sold in modules, according to Dataquest in San Jose. Modules can also add value to more-sophisticated chips.

Intel, beset by competition from both the RISC microprocessors and clones of its own 80x86 family, is looking to add value through the sale of its microprocessors in multichip modules. Intel claims the module eliminates problems that occur when users design systems around faster processors.

Other microprocessor makers—such as LSI Logic Corp., with its Sparc and MIPS-based RISC processors—have recently offered high-performance multichip modules that integrate cache controllers and memory to save design time and cost. In Santa Clara, nChip Inc. claims to offer faster system performance through modules that can integrate entire chip-based subsystems on a single conductive substrate.

The latest 50-MHz version of Intel's 486 MPU, introduced last month, included a 486 packaged in a multichip module containing the processor, a cache memory controller, and nine fast static RAM (SRAM) memory chips.

At the 50-MHz speed timing becomes very critical, notes Michael Slater, president of MicroDesign Resources. High-frequency processors also generate unwanted electronic noise that must be suppressed through additional design work, he adds.

—Hugh G. Willett in San Jose

DESIGN AUTOMATION

VHDL picks up steam

VHDL, THE Pentagon-backed hardware description language devised to simplify the design and manufacture of electronic components and systems, is suddenly picking up steam. Vendors of CAD tools and ASICs have created a group called VHDL International to promote use of the language, design tools are filling critical gaps in the marketplace, and early adapters are settling into VHDL-based design methodologies that offer improved productivity and time to market.

Silicon Graphics, for example, more than tripled its engineering productivity on the design of 14 chips using VHDL-based design and Arche Technologies recently cut development time in half in developing three CMOS ASICs.

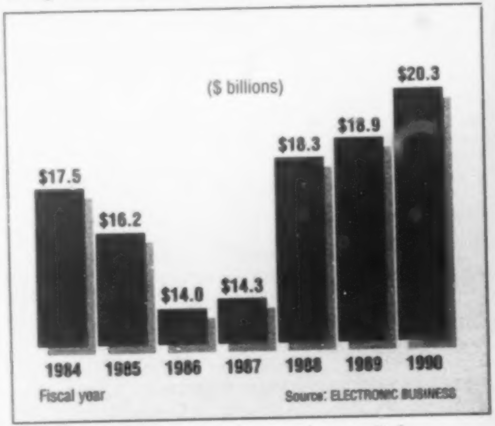
VHDL lets engineers design chips and systems by describing what they do rather than by drawing the gates and transmission lines of which they are composed. When used in conjunction with translation synthesis tools, the language frees engineers to think about what to design rather than how to design it.

Market watchers agree that VHDL is about to get hot. Of 625 designers polled by *EDN* magazine earlier this year, 22% plan to buy VHDL tools in the next year; that earned VHDL fourth place in the magazine's "plan-to-purchase" ranking for 1991. And Dataquest expects VHDL to take 63% of the HDL market by 1994, overtaking a language from Cadence Design Systems, which now holds a 56% share.

—Peter Burrows

CAPITAL INVESTMENT

Capital spending on the rise



Source: ELECTRONIC BUSINESS

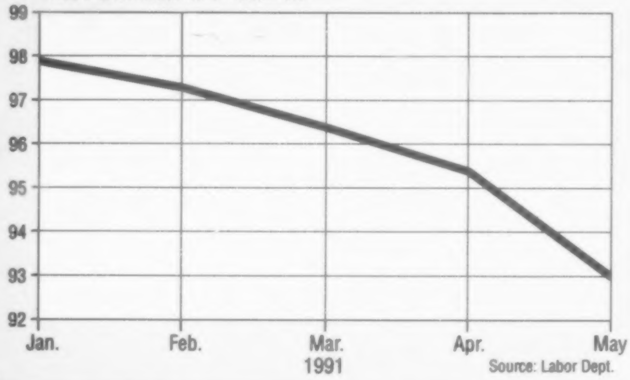
After plummeting in the last recession, capital spending by the top 100 capital spenders in the electronics industry has grown four years in a row. At $20.3 billion, 1990 spending by these companies grew 7.4% above aggregate capital spending by the 100 top spenders in 1989. Watch for our exclusive ranking of the top 100 capital spenders in the next issue.

—Elizabeth B. Baatz

BUSINESS BAROMETER

Price wars tear apart the computer industry...

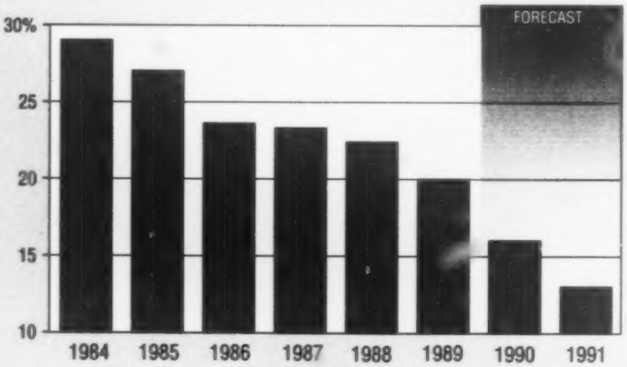
Price index: December 1990=100



Source: Labor Dept.

...and "big iron" revenues retreat worldwide...

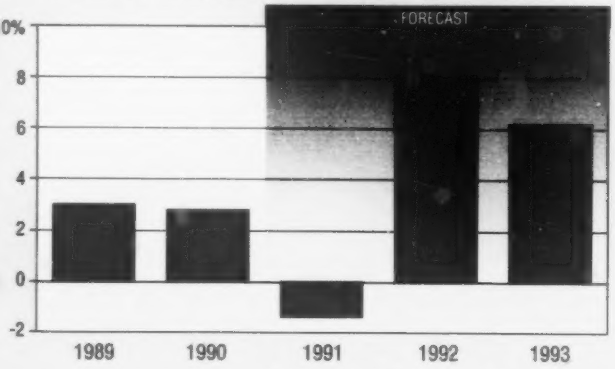
Mainframe & minicomputer share of total information systems revenues



Source: *Datamation* magazine; forecast: Cahners Economics

...leaving U.S. industry shipments vulnerable

Computer & office equipment shipments (annual percentage change)



Source: Commerce Dept.; forecast: Cahners Economics

Time warps, computer wars, and forecasts

LONG AGO, U.S. computer manufacturers enjoyed astronomical growth rates and high profit margins. But unless they can pass through a time warp, computer makers will be living with slower growth and lower margins for some time to come.

According to the U.S. Department of Labor, prices of all computers slid 5% from January to May 1991. The price decline in the desktop market has been even more severe. The shift to lower-margin products began years ago. According to *Datamation* magazine, ELECTRONIC BUSINESS's sister publication, revenues from mainframes and minicomputers accounted for 29% of total information systems revenues in 1984 for the 100 largest worldwide information systems companies. Cahners Economics estimates that share will fall to 13% this year. In response, the onetime "big iron" companies have been shedding people and restructuring in order to lighten their cost loads.

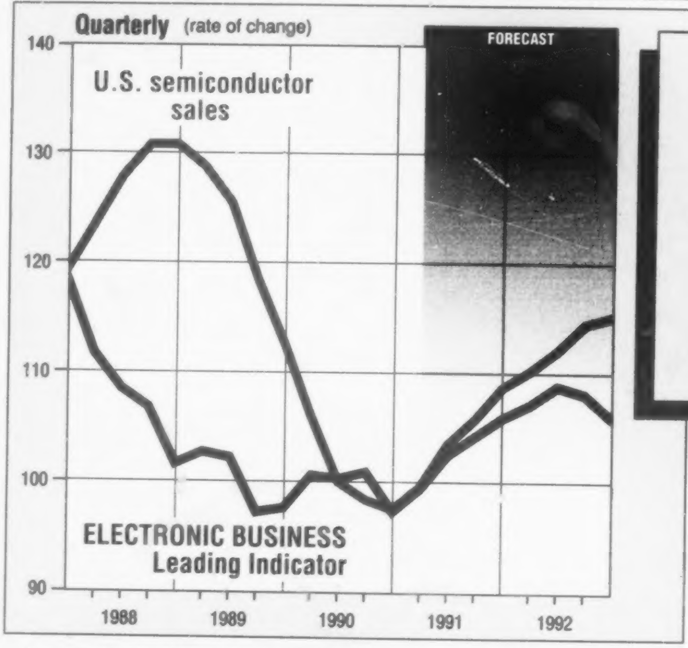
Price erosion, teamed with the general recession, battered away at computer and office equipment shipments this year. Dollar-denominated shipments fell below year-ago levels each month from December 1990 through April 1991.

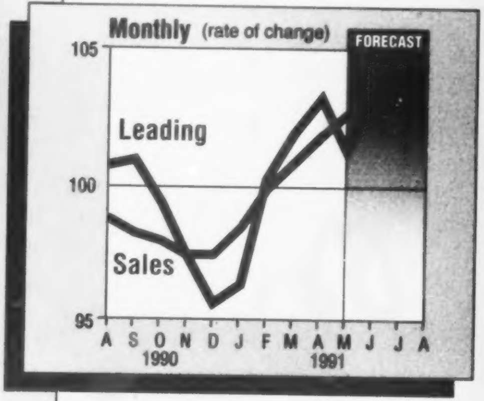
Consequently, Cahners Economics' original shipments forecast, made in December 1990, of 4.4% growth for 1991 has fallen by the wayside. The economic expansion began in June 1991, but shipments growth for computers and office equipment may not fully recover until later this year, leaving annual shipments down 1.4% from 1990.

With the start of the expansionary phase, tenuous as it may be, the price war will evolve into an uneasy truce. Once the battlefield clears, the survivors can enjoy the new world order.

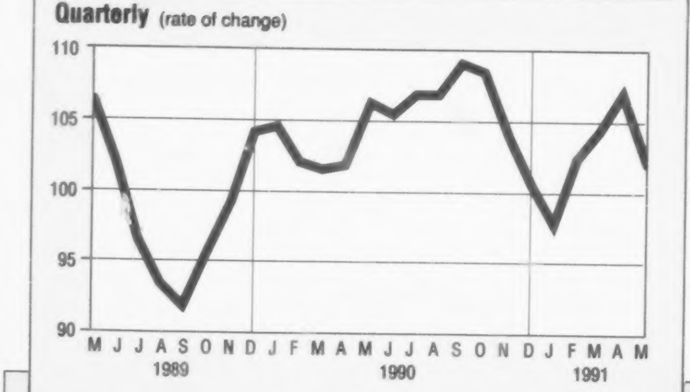
—Madeline Franchi

ELECTRONIC BUSINESS Leading Indicator





Backlash in semiconductor orders drags EBLI



Source: Semiconductor Industry Association

Chip bookings trip up Leading Indicator

THE BRAKES were applied to the ELECTRONIC BUSINESS Leading Indicator (EBLI) in May. After a steady recovery from a low of 95.6 in December 1990 to 103.2 in April, the leading indicator stumbled back to 101.3. Warning: The turnaround in the electronics industry will most likely be a bumpy one and produce a relatively mild expansion. EBLI will peak again in June 1992.

EBLI is a weighted composite of six statistics that tend to lead activity in the electronics industry. To obtain your complimentary background paper, contact Cahners Economics, 275 Washington St., Newton, MA 02158-1630; telephone (617) 630-2119; fax (617) 630-2100

	Latest month	Previous month	Year ago	1990 average
ELECTRONIC BUSINESS Leading Indicator (rate of change, May)	101.3	103.2	100.9	99.9
U.S. semiconductor bookings ($ millions, 3-month average, May)	$1,348	$1,448	$1,400	$1,254
Weekly hours of semiconductor production workers (monthly average, Apr.)	40.7	41.1	41.0	40.4
Electronic components lead time index (1977 = 100, Jun.)	94.2	93.3	82.4	80.7
S&P's semiconductor stock price index (1970 =10, monthly average, May)	73.2	74.8	74.6	64.6
Change in electronic components inventories ($ millions, SA, Apr.)	$85	$19	$46	$33
Contracts and orders for plant and equipment ($ billions, SA, Apr.)	$33.4	$35.0	$37.3	$38.2

SA = seasonally adjusted; all other data are not seasonally adjusted

Sources: Semiconductor Industry Association, Bureau of Labor Statistics, *Electronics Purchasing*, Standard & Poor's, Commerce Dept. , Bureau of Economic Analysis

Hard slogging in the Japanese market

Growth slows, earnings suffer at top U.S. and European electronics companies in Japan

By Paula Doe

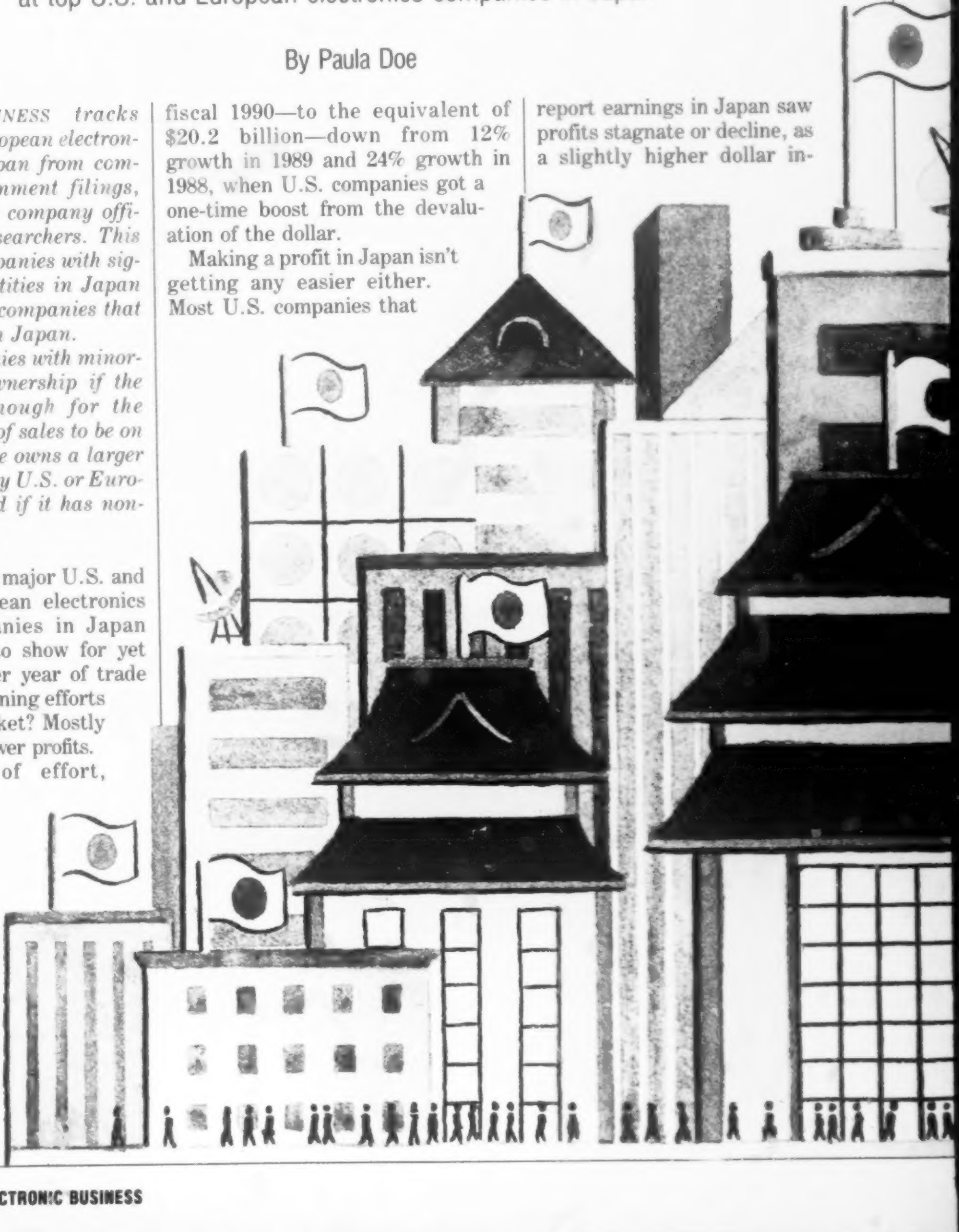
ELECTRONIC BUSINESS tracks sales of U.S. and European electronics companies in Japan from company reports, government filings, and discussions with company officials and market researchers. This net should catch companies with significant corporate entities in Japan but does not include companies that sell through agents in Japan.

We include companies with minority non-Japanese ownership if the company is big enough for the minority percentage of sales to be on our list; if no one else owns a larger stake; if it sells largely U.S. or European technology; and if it has non-Japanese managers.

What do major U.S. and European electronics companies in Japan have to show for yet another year of trade talks and market opening efforts in the Japanese market? Mostly slower growth and lower profits.

Despite years of effort, growth for most U.S. and European companies in Japan isn't picking up—in fact, it's slowing down. The 20 largest U.S.-owned electronics companies in Japan increased their total yen-based sales in the Japanese market by 9% in fiscal 1990—to the equivalent of $20.2 billion—down from 12% growth in 1989 and 24% growth in 1988, when U.S. companies got a one-time boost from the devaluation of the dollar.

Making a profit in Japan isn't getting any easier either. Most U.S. companies that report earnings in Japan saw profits stagnate or decline, as a slightly higher dollar in-



James Steinberg

creased the cost of imports to Japan. Big computer makers IBM Japan, Nihon Unisys, and DEC Japan saw earnings plummet between 19% and 60% as the Japanese financial institutions on which they depend cut purchases.

Granted, 1990 was also a tough year for Japanese companies. The Electronic Industry Association of Japan (EIAJ) estimates total electronics production by Japanese companies climbed only 5% for the year, although that figure largely reflects recession in other countries, which trimmed demand for exports from Japan.

More significant for U.S. electronics companies, Japan's booming real estate and financial markets slowed down, so banks and securities companies cut spending.

Still, Japanese GNP kept up the same steady 5% growth in 1990 as in 1989, and most analysts figure the country's computer market saw around 10% growth. Major Japanese

Top U.S. and European electronics companies in Japan

	Sales in Japan ($ millions)	% change (in yen)	Total sales* ($ millions)	Net Income ($ millions)	% change (in yen)	Fiscal year	Ownership
1 **IBM Japan**	$6,735	2	$9,212	$575	-19	12/90	IBM 100%
2 **Fuji Xerox**	3,744	10	3,744	161	4	10/90	Rank Xerox 50%, Fuji Photo Film 50%
3 **Nihon Unisys**	2,369	13	2,369	14	-57	3/91	Unisys 33.3%, Mitsui 33.3%
4 **Yokogawa HP**	1,047	17	1,117	67	-3	10/90	HP 75%, Yokogawa Electric 25%
5 **Yamatake Honeywell**	1,020	10[1]	1,211	37	-34	9/90	Honeywell 24.1%
6 **DEC Japan**	720	9	894	30	-54	6/90	DEC 100%
7 **NCR Japan**	717	2	830	69	0	11/90	NCR 100%
8 **Motorola**	650	29[2]	NA	NA	NA	12/90	NA
9 **TI Japan**	614	5	1,035	-69	NM	12/90	Texas Instruments 100%
10 **AMP Japan**	465	10	NA	NA	NA	11/90	AMP 100%
11 **Nihon Sun**	370	60	NA	NA	NA	6/90	Sun 100%
12 **Intel Japan**	367	27	NA	NA	NA	12/90	Intel 100%
13 **Yokogawa Medical**	260	20[1]	433	NA	NA	11/90	GE 75%, Yokogawa Electric 25%
14 **Olivetti Japan**	245	9	245	0.5	-62	12/90	Olivetti 80%, Toshiba 20%
15 **Philips**	230[3]	38[1]	362[4]	7[4]	234[4]	12/90	Philips 51%
16 **Applied Materials Japan**	196	5	196	NA	NA	10/90	Applied Materials 100%
17 **Sony Tektronix**	185	-8	192	NA	NA	5/90	Tektronix 50%, Sony 50%
18 **Memorex Telex**	179	10	267	2	-62	3/91	Memorex Telex 52.2%, Kanematsu 24.5%
19 **National Semiconductor**	143	3	NA	NA	NA	12/90	NA
19 **Tandem Computer**	143	31	143	NA	NA	9/90	Tandem 100%
21 **Apple Japan**	140	NA	NA	NA	NA	9/90	Apple 100%
21 **Molex Japan**	140	5[1]	203	26	-8	6/90	Molex 100%
23 **AMD**	139	1	180	NA	NA	12/90	AMD 100%
24 **Nemic Lambda**	105	NA	105	9	NA	5/90	Veeco 64%, Rikizo Madarame 24.9%
25 **Nippon Data General**[5]	102	-12	102	NA	NA	9/90	Data General 85%

All yen converted at the 1990 average rate of Y144/$1. Companies with different fiscal years used slightly different exchange rates in their own reporting

[1] Growth of total sales of Japanese unit

[2] Growth of semiconductor sales only

[3] Sales of Marantz Japan (audio, video, telecommunications equipment, and semiconductors) only. Does not include other Philips imports

[4] Figures for Marantz Japan

[5] Aquired by Omron Mar. 1991

*Sales in Japan plus exports to U.S. and other countries

NA = not available

NM = not meaningful

Source: ELECTRONIC BUSINESS; semiconductor sales figures supplied by Dataquest Inc.

The top 12 electronics companies in Japan

Sales in Japan ($ billions)

Hitachi	$34.3	IBM Japan (U.S.)	6.7
Matsushita	20.4	Sony	5.5
Toshiba	18.4	Sanyo	5.2
NEC	16.2	Sharp	4.3
Mitsubishi Electric	14.6	Fuji Xerox (U.S.)	3.7
Fujitsu	12.3	Ricoh	3.4

Source: ELECTRONIC BUSINESS

computer makers managed double-digit growth at home. Fujitsu Ltd.'s computer sales in Japan climbed 17% to about $10.1 billion in 1990. Toshiba Corp.'s sales were up 16% to $3.04 billion, NEC Corp. saw sales rise 13% to $9.1 billion, and Hitachi Ltd.'s sales increased 11% to $6.75 billion.

In contrast, IBM Japan's sales increased a mere 2% to $6.74 billion, relegating the U.S. giant to fourth place in the Japanese computer market, behind Fujitsu, NEC, and Hitachi. NCR Japan, at 2% growth, and DEC Japan, at 9%, also lagged their Japanese competitors. Their $700 million or so in sales was dwarfed by all the Japanese computer makers.

Some U.S. companies did very well. Motorola Inc. and Intel Corp. increased their sales of semiconductors in Japan by 29% and 27% respectively, to $438 million and $367 million, outpacing the growth of the big Japanese suppliers. EIAJ estimates that total Japanese semiconductor output declined 1% in 1990.

Some computer makers made big gains too. Sun Microsystems Inc. saw 60% growth, reaching sales of roughly $370 million in Japan. Tandem Computers Inc. increased its sales by 31%, to $143 million, making our list of leading companies for the first time.

Respectable showings were also made by some larger companies, whose bigger bases make double-digit gains amount to some real money. Yokogawa-Hewlett-Packard achieved 17% growth in the Japanese market, reaching sales of $1 billion; the acquisition of Apollo Computer Inc.'s Japanese subsidiary accounted for part of the increase. Nihon Unisys increased its sales 13%, to $2.37 billion, matching the major Japanese computer makers' growth rates, although earnings suffered.

At the risk of repeating a too familiar story, it is worth noting that $20 billion sales of major U.S. electronics companies in Japan is small potatoes compared with total Japanese electronics production that the EIAJ puts at some $184 billion.

This year we added European-owned companies in Japan to our annual listing but found only three players with sales above the $100 million mark. Sales of all top 25 U.S. and European electronics companies in Japan reached $21 billion. Any one of the leading Japanese electronics companies sells almost that much in Japan on its own. Hitachi's sales in Japan reached $34 billion in 1990, Matsushita Electric Industrial's sales were $20 billion, NEC's were $16 billion, Mitsubishi Electric had $14 billion in sales, and Fujitsu had $12 billion.

Of course there are many smaller U.S. electronics companies in Japan that aren't included on our list, but even 20 more companies with sales of $50 million each would add only another $1 billion to the total.

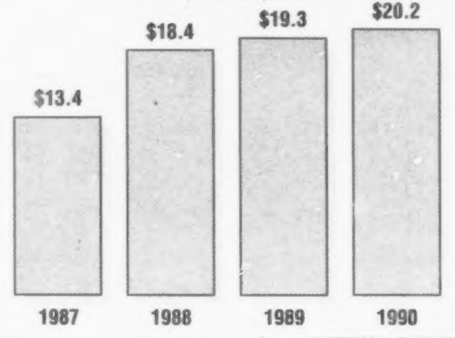
MOST SUCCESSFUL among the European companies in Japan are N.V. Philips and Ing. C. Olivetti. Olivetti's 80%-20% joint venture with Toshiba reports about $245 million in sales of Olivetti and Toshiba computers and office automation equipment in Japan.

Philips's Japanese manufacturing unit, Marantz Japan, increased its total sales by 38% in 1990, to $362 million, selling about $154 million of that audio, video, and telecommunications equipment in Japan. Philips also sold about $72 million worth of semiconductors in Japan, according to estimates of Dataquest Inc. of San Jose. Philips Japan also claims $500 million in sales from Japanese customers for electronic components delivered to Japanese plants in Europe and the Americas.

Other big European names in electronics aren't doing big volume in Japan. Siemens's Japanese subsidiary reports that its sales in Japan are about $50 million, while Thomson S.A. increased its semiconductor sales 82% to $40 million. □

Sales by top 20 U.S. electronics companies in Japan

($ billions)



Source: ELECTRONIC BUSINESS

TOP 100 R&D SPENDERS

Dog days for R&D

Despite healthy sales and profits growth last year, R&D spending by top U.S. electronics companies rose by just 5.3%

By Charles Procter

It was a year for caution. Sales by the top 100 U.S. electronics R&D spenders in 1990 grew by 9.0%, and profits posted a whopping 20.7% increase. But research and development spending rose by a meager 5.3%. This growth rate marks a three-year low, having peaked at 22.9% in 1987.

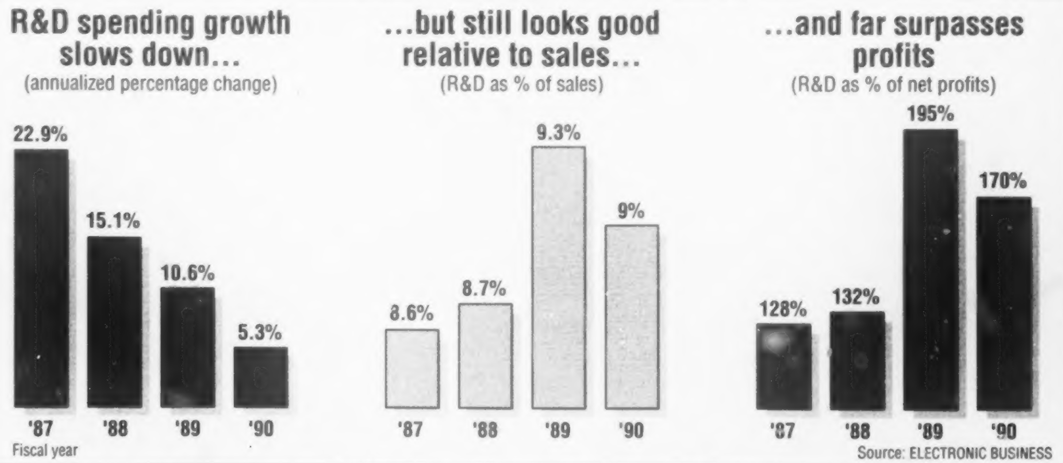
These 100 companies accounted for about 29% of all company-funded R&D spending in the United States last year. But the mediocre showing among the best and brightest in the industry is probably not a sign of serious trouble. Instead it simply reflects the strong relationship between sales, profits, market expectations, and R&D spending, says John Gawalt, a science resource analyst at the National Science Foundation in Washington, D.C.

Total R&D spending for these companies rose to $21.2 billion last year, up from $20.1 billion in 1989. As a percentage of sales, R&D dropped to 9.0% in 1990 from a high of 9.3% in 1989. This dip may be explained in part by the fact that over half of the companies on the list posted losses or declines in profits. "It's hard to spend it when you don't have it," offers one executive. And considering the effects of the recession and the expectations for slow market growth ahead, many companies capped R&D spending growth in 1990 and may do so again in 1991 unless demand rebounds.

There are exceptions, of course. One is Cypress Semiconductor Corp., the San Jose maker of SRAMs. Cypress topped this year's list by spending 24.7% of sales on R&D in 1990, up slightly from 23.9% in 1989. CEO T. J. Rodgers developed a financial model that calls for maintaining R&D at between 24% and 25% of sales a year, says Antonio Alvarez, Cypress's vice president of R&D. About a quarter of that money goes to process-related R&D and the rest to product development. Heavy R&D spending has been a key to the company's success, say observers, and Cypress has maintained consistent sales and profit growth over the last few years as it diversifies into new markets.

Other high fliers are following in

The top 100 electronics R&D spenders



Source: ELECTRONIC BUSINESS

Measuring the top U.S. R&D spenders

R&D expenditures ($ millions)		R&D spending growth (percentage change from 1989)		R&D spending per employee	
IBM	$6,554.0	**Seagate Technology**	103.6%	**Chips and Technologies**	$68,456
Digital Equipment	1,614.4	**Archive**	79.9	**Cypress Semiconductor**	34,829
Hewlett-Packard	1,367.0	**Encore Computer**	71.9	**Amdahl**	34,643
Motorola	1,008.0	**Oracle Systems**	67.9	**Quantum**	33,776
Xerox	848.0	**Silicon Valley Group**	66.6	**Apple Computer**	32,903
Unisys	746.5	**Micron Technology**	66.5	**Microsoft**	32,052
GM Hughes Electronics	568.0	**Microsoft**	63.9	**Applied Materials**	29,584
Texas Instruments	540.0	**Sequent Computer**	62.6	**Lotus Development**	29,329
Intel	516.7	**Conner Peripherals**	58.5	**Mentor Graphics**	27,138
NCR	502.0	**Teradata**	53.8	**Cray Research**	26,440

Fiscal year 1990

Source: ELECTRONIC BUSINESS

Cypress's footsteps. Fourth-ranked Cadence Design Systems, a first-time entrant on our R&D ranking, translates strong R&D spending into solid sales and profit growth. With an R&D spending rate of 18.4%, Cadence posted sales growth of 44.8% and a 45% jump in profits last year.

Like Cypress and Cadence, strong R&D spending is the cornerstone of Chips and Technologies Inc.'s success. Ranked #11 this year in terms of R&D spending as a percentage of sales, Chips and Technologies tops the list for R&D spending per employee, shelling out $68,456 for each of its 665 employees. As a fabless semiconductor company driven by a need for ever-faster product development, the company is entirely dependent on R&D spending to stay ahead of the competition in the chip-set business. Over 70% of its employees are classified as R&D personnel, and it spends twice as much per employee as Cypress and almost six times more than the average company on the list. The company points to its 1990 sales growth of 34.8% as proof that its R&D spending strategy works.

Still, companies like Chips and Technologies, Cypress, and Cadence are small fry when compared with IBM, which again this year topped the list for total R&D dollars. Big Blue's 1990 R&D budget totaled $6.6 billion, accounting for nearly one-third of all spending by the top 100 electronics companies. A wary IBM cut R&D spending by 4% in 1990, or $273 million, from a $6.8 billion level in 1989. Even so, it outspent even General Motors last year, to top the list for U.S. corporate R&D spenders. Other big electronics spenders include Digital Equipment Corp. (#29), Hewlett-Packard Co. (#43), Motorola Inc. (#52), and Xerox Corp. (#75). Together with IBM, these companies spent $11.4 billion on R&D in 1990, or half the total of the top 100. All five reported positive sales growth, and all but DEC and HP posted profit increases.

Nineteen companies out of the 100 curtailed R&D spending in 1990, down from 21 the previous year. Most notable this year was Control Data Corp., #69 on the list. CDC shrank its corporate R&D budget by 49.1% due to the sale or discontinuation of various operations (particularly Imprimis Technology, its disk-drive operation, which was sold to Seagate Technology Inc.). Ashton-Tate, the top R&D spender in 1989, saw its R&D spending shrink by 42.2% because of cost-reduction programs and completion of certain software development projects.

At the other end of the spectrum were the companies that experienced meteoric increases in R&D spending. Leading this list was Seagate Technology (#93), posting a 103.6% increase in R&D spending for the year (the result of the Imprimis Technology acquisition from CDC). Similarly significant increases were recorded by Archive (#66), Encore Computer (#16), and Oracle Systems (#54).

BY MOST ACCOUNTS, R&D budgeting in 1991 will reflect the continued uncertainty that pervaded budgeting plans in 1990. Even as the U.S. economy emerges from the recession, don't expect a sharp increase in R&D spending this year. In fact, the industry may continue to view R&D as an area to extract savings.

This may not be such a bad thing. There is a lot of talk in corner offices about the need for improving the product development process rather than continuing to throw money into the R&D pit. Companies are finding ways to work smarter instead of harder at invention, design, and process improvement. As a result of this change in philosophy, traditional R&D measures may no longer accurately reflect U.S. electronics companies' investment in the future.

continued

To qualify for the ELECTRONIC BUSINESS R&D ranking, companies must be U.S.-based, publicly traded, derive at least 50% of their revenue from electronics-related sales, and be included in the ELECTRONIC BUSINESS 200 listing.

INVESTMENT

TOP 100 R&D SPENDERS

R&D rank 1990	1989	**Company**/Location	R&D as % sales	R&D expenditures ($ millions)	% change from 1989	Fiscal 1990 sales ($ millions)	% change from 1989	Fiscal 1990 profits ($ millions)	% change from 1989	Fiscal year
1	2	**Cypress Semiconductor** San Jose	24.7%	$55.6	16.7%	$225.2	13.0%	$33.2	8.2%	12/90
2	5	**Integrated Device Technology** Santa Clara	19.9	41.6	35.1	209.5	15.9	17.0	-5.2	3/90
3	4	**Advanced Micro Devices** Sunnyvale, Calif.	19.2	203.7	0.9	1,059.2	-4.1	-53.6	NM	12/90
4	—	**Cadence Design Systems** San Jose	18.4	42.6	37.0	231.4	44.8	38.0	45.0	12/90
5	1	**Ashton-Tate** Torrance, Calif.	17.2	39.7	-42.2	230.5	-13.1	-18.1	NM	12/90
6	17	**Mentor Graphics** Wilsonville, Ore.	17.1	74.5	46.3	435.2	14.5	23.6	-47.3	12/90
7	13	**Applied Materials** Santa Clara	17.1	97.1	34.3	567.1	13.0	34.1	-33.8	10/90
8	10	**Analog Devices** Norwood, Mass.	16.6	80.3	16.5	485.2	7.0	-12.9	NM	10/90
9	7	**VLSI Technology** San Jose	16.5	53.6	14.8	324.8	12.6	-12.7	NM	12/90
10	3	**Cray Research** Eagan, Minn.	16.0	128.4	-10.4	804.4	2.5	113.0	26.9	12/90
11	9	**Chips and Technologies** San Jose	15.5	45.5	35.7	293.4	34.8	29.3	-11.3	6/90
12	16	**Microsoft** Redmond, Wash.	15.3	180.6	63.9	1,183.4	47.3	279.2	63.7	6/90
13	8	**National Semiconductor** Santa Clara	15.1	252.4	-4.7	1,675.0	1.6	-29.3	NM	5/90
14	6	**Lotus Development** Cambridge, Mass.	15.0	102.7	8.8	684.5	23.1	23.3	-65.8	12/90
15	23	**Tellabs** Lisle, Ill.	15.0	31.6	33.4	211.0	16.4	8.1	14.9	12/90
16	—	**Encore Computer** Fort Lauderdale, Fla.	14.8	31.8	71.9	215.2	36.3	-30.1	NM	12/90
17	19	**Teradyne** Boston	14.6	66.9	4.6	458.9	-5.1	-21.3	NM	12/90
18	22	**Amdahl** Sunnyvale, Calif.	14.4	310.1	11.8	2,158.8	2.7	184.0	20.3	12/90
19	20	**Stratus Computer** Marlborough, Mass.	14.2	57.4	27.2	403.9	18.3	37.0	4.5	12/90
20	21	**Tektronix** Beaverton, Ore.	13.8	194.6	2.9	1,408.3	-1.7	-92.6	NM	5/90
21	—	**Silicon Valley Group** San Jose	13.7	25.3	66.6	184.3	40.6	4.4	-53.7	9/90
22	26	**Tandem Computers** Cupertino, Calif.	13.6	253.6	24.6	1,865.9	14.3	121.8	3.0	9/90
23	25	**Computer Associates** Garden City, N.Y.	13.2	171.2	28.3	1,296.0	25.8	157.8	-3.5	3/90
24	29	**Intel** Santa Clara	13.2	516.7	41.5	3,921.3	25.4	650.3	66.3	12/90
25	15	**Teradata** El Segundo, Calif.	13.0	29.1	53.8	224.2	63.2	18.8	89.4	6/90
26	—	**Convex Computer** Richardson, Tex.	13.0	27.2	31.4	209.3	32.0	18.4	61.0	12/90
27	31	**Concurrent Computer** Tinton Falls, N.J.	12.7	43.0	33.5	340.1	22.3	-41.7	NM	6/90
28	—	**Borland International** Scotts Valley, Calif.	12.6	14.3	-0.1	113.3	25.1	11.8	NM	3/90
29	27	**Digital Equipment** Maynard, Mass.	12.5	1,614.4	5.9	12,942.5	1.6	74.4	-93.1	6/90
30	18	**Sun Microsystems** Mountain View, Calif.	12.2	301.9	28.9	2,466.2	39.7	111.2	82.7	6/90
31	54	**Bolt Beranek and Newman** Cambridge, Mass.	12.1	31.6	28.2	261.9	-10.2	-34.8	NM	6/90
32	39	**Novell** Provo, Utah	11.9	59.3	38.6	497.5	17.9	94.3	94.3	10/90
33	41	**Westmark International** Seattle	11.8	57.0	32.2	484.9	10.5	16.4	-13.8	12/90
34	24	**Data General** Westboro, Mass.	11.6	140.7	-17.9	1,216.4	-7.5	-139.8	NM	9/90
35	37	**Coherent** Palo Alto, Calif.	11.5	21.9	3.2	191.2	-5.2	-0.4	NM	9/90
36	—	**Pyramid Technology** Mountain View, Calif.	11.3	20.3	39.0	179.7	73.0	16.8	101.3	9/90
37	28	**Silicon Graphics** Mountain View, Calif.	10.9	45.6	45.5	419.8	59.1	32.3	180.8	6/90
38	90	**Micron Technology** Boise, Idaho	10.7	35.6	66.5	333.3	-25.3	4.9	-95.4	8/90
39	35	**Intergraph** Huntsville, Ala.	10.5	110.1	20.3	1,044.6	21.5	62.6	-21.3	12/90
40	40	**3Com** Santa Clara	10.4	43.7	13.8	419.1	8.6	20.5	-40.3	5/90
41	33	**General DataComm** Middlebury, Conn.	10.4	21.0	-3.1	201.5	0.2	0.4	NM	9/90
42	—	**Sequent Computer Systems** Beaverton, Ore.	10.4	25.8	62.6	248.8	70.9	18.8	36.9	12/90
43	34	**Hewlett-Packard** Palo Alto, Calif.	10.3	1,367.0	7.7	13,233.0	11.2	739.0	-10.9	10/90
44	—	**Autodesk** Sausalito, Calif.	10.3	24.4	14.4	237.9	33.2	56.8	22.4	1/91
45	38	**DSC Communications** Plano, Tex.	10.0	51.8	17.9	519.3	20.8	20.3	-40.5	12/90
46	47	**Beckman Instruments** Fullerton, Calif.	9.9	80.6	14.7	815.2	3.7	36.2	-13.6	12/90
47	42	**Dynatech** Burlington, Mass.	9.8	42.5	8.5	433.3	8.5	14.7	-20.7	3/90
48	49	**ADC Telecommunications** Minneapolis	9.8	25.5	46.7	259.8	32.3	22.9	39.6	10/90
49	32	**IBM** Armonk, N.Y.	9.5	6,554.0	-4.0	69,018.0	10.1	6,020.0	60.2	12/90
50	—	**Acuson** Mountain View, Calif.	9.5	26.8	32.7	282.8	24.4	47.8	25.7	12/90

NM = not meaningful

TOP 100 R&D SPENDERS

R&D rank 1990	R&D rank 1989	Company/Location	R&D as % sales	R&D expenditures ($ millions)	% change from 1989	Fiscal 1990 sales ($ millions)	% change from 1989	Fiscal 1990 profits ($ millions)	% change from 1989	Fiscal year
51	48	**Medtronic** Minneapolis	9.5%	$79.4	20.3%	$836.6	12.8%	$108.7	11.6%	4/90
52	57	**Motorola** Schaumburg, Ill.	9.3	1,008.0	28.6	10,885.0	13.1	499.0	0.2	12/90
53	43	**LSI Logic** Milpitas, Calif.	9.2	60.2	14.8	655.5	19.9	-34.0	NM	12/90
54	45	**Oracle Systems** Redwood Shores, Calif.	9.1	88.3	67.9	970.8	66.3	117.4	43.6	5/90
55	53	**Wang Laboratories** Lowell, Mass.	8.9	221.9	-8.8	2,497.2	-13.0	-628.6	NM	6/90
56	44	**AMP** Harrisburg, Pa.	8.6	263.0	4.0	3,043.6	8.8	287.1	2.2	12/90
57	50	**Storage Technology** Louisville, Colo.	8.6	98.4	14.8	1,140.6	16.1	70.6	93.7	12/90
58	60	**Apple Computer** Cupertino, Calif.	8.6	478.0	13.8	5,558.4	5.2	474.9	4.6	9/90
59	55	**Fluke** Everett, Wash.	8.5	19.9	-3.5	233.8	-5.6	12.2	-47.4	9/90
60	58	**Applied Magnetics** Goleta, Calif.	8.5	31.2	22.9	368.3	17.3	-10.0	NM	9/90
61	62	**Texas Instruments** Dallas	8.2	540.0	6.7	6,567.0	0.7	-39.0	NM	12/90
62	67	**NCR** Dayton	8.0	502.0	12.6	6,285.0	5.5	369.0	-10.4	12/90
63	70	**Ask Computer Systems** Mountain View, Calif.	8.0	16.5	23.3	207.5	11.4	5.0	-63.1	6/90
64	80	**Watkins-Johnson** Palo Alto, Calif.	7.9	24.5	32.5	311.9	0.4	13.0	-30.4	12/90
65	51	**Western Digital** Irvine, Calif.	7.7	82.1	-4.9	1,070.5	7.9	24.2	-29.6	6/90
66	73	**Archive** Costa Mesa, Calif.	7.6	22.3	79.9	293.2	61.6	11.5	-24.7	9/90
67	65	**Measurex** Cupertino, Calif.	7.6	20.2	-6.7	266.2	-6.7	22.5	-44.6	11/90
68	61	**Perkin-Elmer** Norwalk, Conn.	7.6	63.4	3.0	837.7	6.8	44.2	-5.7	7/90
69	52	**Control Data** Minneapolis	7.5	127.1	-49.1	1,691.0	-42.4	2.7	NM	12/90
70	63	**Unisys** Blue Bell, Pa.	7.4	746.5	-4.5	10,111.3	0.1	-436.7	NM	12/90
71	75	**Maxtor** San Jose	7.2	35.6	51.1	491.1	39.9	18.9	263.4	3/90
72	74	**Gerber Scientific** South Windsor, Conn.	6.7	20.7	2.6	307.2	2.6	32.4	-1.3	4/90
73	84	**Scientific-Atlanta** Atlanta	6.5	39.7	28.9	614.3	12.4	44.3	22.1	6/90
74	88	**Everex Systems** Fremont, Calif.	6.4	27.7	42.7	436.5	15.7	24.5	15.1	7/90
75	76	**Xerox** Stamford, Conn.	6.2	848.0	4.8	13,583.0	9.3	599.0	22.7	12/90
76	56	**Diasonics** Milpitas, Calif.	6.2	16.5	2.8	267.1	37.5	16.4	NM	12/90
77	83	**Andrew** Orland Park, Ill.	6.2	22.6	32.6	366.0	21.2	18.2	11.9	9/90
78	78	**Varian Associates** Palo Alto, Calif.	6.1	77.4	-6.8	1,264.8	-5.9	12.6	-60.0	9/90
79	69	**BancTec** Dallas	6.1	11.3	26.0	185.8	50.4	10.5	36.6	3/90
80	59	**Quantum** Milpitas, Calif.	5.8	25.8	53.4	446.3	114.5	47.2	266.4	3/90
81	81	**Atari** Sunnyvale, Calif.	5.6	22.9	-7.1	411.5	-2.9	-20.8	NM	12/90
82	86	**Molex** Lisle, Ill.	5.5	32.7	9.6	594.4	3.9	62.1	7.6	6/90
83	82	**Loral** New York	5.5	70.0	4.3	1,274.3	7.4	77.5	28.5	3/90
84	64	**Micropolis** Chatsworth, Calif.	5.3	20.3	-13.2	380.6	23.8	7.9	NM	12/90
85	93	**Compaq Computer** Houston	5.2	185.7	40.2	[illegible]598.8	25.1	454.9	36.5	12/90
86	87	**GM Hughes Electronics** Detroit	4.8	568.0	-4.1	1[illegible]3.1	3.2	577.2	-8.7	12/90
87	91	**Harris** Melbourne, Fla.	4.8	145.2	39.6	3,[illegible]7	37.9	130.7	12.5	6/90
88	85	**Conner Peripherals** San Jose	4.7	62.9	58.5	1,337.6	89.8	130.1	213.8	12/90
89	—	**Augat** Mansfield, Mass.	4.5	13.6	24.8	299.2	-2.4	17.1	15.0	12/90
90	92	**Honeywell** Minneapolis	4.4	279.6	-1.4	6,309.1	4.1	371.8	-32.4	12/90
91	94	**Kollmorgen** Simsbury, Conn.	4.4	10.5	0.5	238.5	4.7	3.9	NM	12/90
92	79	**Esterline** Bellevue, Wash.	4.4	17.0	-2.0	389.1	36.9	7.1	-10.3	10/90
93	97	**Seagate Technology** Scotts Valley, Calif.	4.3	104.1	103.6	2,413.2	75.9	117.2	NM	6/90
94	—	**Recognition Equipment** Irving, Tex.	4.3	9.9	52.6	230.6	-9.9	-31.7	NM	10/90
95	—	**Diebold** Canton, Ohio	4.3	20.3	51.0	476.1	1.5	27.1	-25.2	12/90
96	89	**Dell Computer** Austin, Tex.	4.1	22.4	33.0	546.2	61.3	27.2	432.5	1/91
97	—	**Zenith Electronics** Glenview, Ill.	4.0	55.9	8.8	1,409.9	-9.0	-52.3	NM	12/90
98	—	**Symbol Technologies** Bohemia, N.Y.	3.8	8.7	13.2	231.5	4.1	7.6	-60.1	12/90
99	—	**Qume** Milpitas, Calif.	3.7	8.3	12.8	222.3	21.3	8.7	72.2	2/90
100	98	**AST Research** Irvine, Calif.	3.5	18.4	8.8	533.8	16.9	35.1	NM	6/90

NM = not meaningful

Viewing the terminal market through X windows

X-terminal sales seem set for steady growth. But early entrants into the market feel the heat from computer companies and Asian clones

By Rick Whiting

A battle royale is shaping up in yet another booming computer market. Sales of X terminals, sophisticated desktop displays positioned above so-called dumb terminals and below more costly PCs and workstations, are expected to double to $324 million this year. Unfortunately, the vendors who pioneered the product are threatened by the turmoil within the fast-growing but maturing market.

Major computer vendors such as IBM, Digital Equipment Corp., and Hewlett-Packard Co. have made major inroads into the market, and Asian clone makers are about to invade in force. Worse, X-terminal makers are being squeezed by the PC and workstation price wars. The volatile nature of the X-terminal market leads Stephen J. King, marketing director for Tektronix Inc.'s Network Displays Division, to paraphrase a famous Andy Warhol quote to describe the turmoil: "Every vendor has had its 15 minutes of glory."

Much of the market mayhem is due to the functionality and positioning of X terminals, which are caught in the heated price and performance competition among personal computers, workstations, and computer terminals. "We view [X terminals] as part of the battle for the desktop," explains industry analyst Patty Chang of Dataquest, Inc., San Jose. X terminals are designed to take advantage of the X Window System, a windowing standard developed by the Massachusetts Institute of Technology in the mid-1980s. X windows allows users to access multiple applications running on minicomputers, servers, or workstations in a network.

The first X terminals hit the street in 1988 and 1989 from pioneers Network Computing Devices Inc. (NCD) in Mountain View, Calif., Visual Technology Inc. of Westborough, Mass., Human Designed Systems Inc. of King of Prussia, Pa., and Tektronix's Network Displays Division of Wilsonville, Ore. Distributors, OEMs, and end users were delighted at the rock-bottom prices for PC- or workstation-like functionality, and sales took off.

Liane Enkelis

NCD's co-founder Judy Estrin says that, while the X terminal market is still embrionic, the devices are viable contenders with PCs and workstations for the desktop

Eileen O'Brien, director of Framingham, Mass.-based International Data Corp.'s terminal service, says that X-terminal vendors shipped 64,000 units last year at a total value of $161 million, up from 13,000 units valued at $41 million in 1989. She expects 1991 shipments to hit 136,000 units valued at $324 million. Dataquest's Chang says X terminals currently sell for as low as $1,000, and the average price is about $2,500. Though high-end X-terminal units cost more, they are more than competitive with diskless workstations at $4,000.

Providing a boost for the market is the growing number of color X terminals now being shipped by most vendors. Because color allows users to take better advantage of X-terminal capabilities, such as the three-dimensional effect of the Motif graphical user interface, the availability of color X terminals is spurring sales. "We're seeing color terminals have much more of an influence than people had anticipated," says Tom Arthur, IBM's X station product development manager. IDC's O'Brien expects that 43% of all X terminals shipped this year will be color.

Attractive prices are also expected to encourage robust market growth. O'Brien predicts annual revenue growth of 30% to 40% for the market, while Dataquest's Chang forecasts more than 50% compounded average annual growth between 1991 and 1995, to $1 billion by mid-decade. "This is one of our fastest-growing markets right now," says Dave Morse, marketing manager at HP's Panacom Automation Division in Waterloo, Ont. "We view it as a tremendous opportunity."

While most marketing managers would be thrilled at 30% to 50% growth rates, current forecasts are a sharp comedown from earlier predictions. Several years ago Gartner Group Inc., a Stamford, Conn., market research firm, foresaw annual sales of X terminals reaching 200,000 units in 1990 and a half a million units this year. The shortfall from Gartner's earlier prediction reflects the maturing market faced by X-terminal makers. Indeed, Forrester Research Inc., Cambridge, Mass., last year estimated that X terminals would remain a niche market, peaking at only 200,000 units per year by 1994.

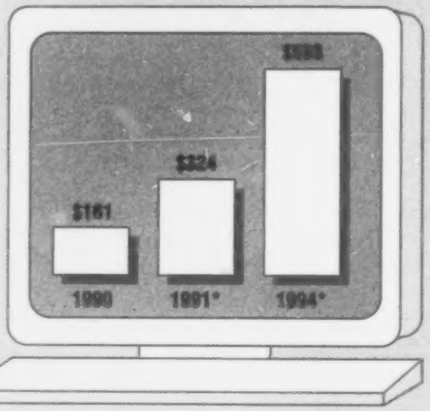
Dataquest estimates that worldwide, 74% of all installed desktop systems are personal computers, with text terminals accounting for another 22.8%, workstations 1.4%, and X terminals a minuscule 0.4%, followed by proprietary graphics terminals and other specialized displays.

Marketers of X terminals, in fact, often find themselves competing with workstation suppliers as much as with each other. Since Sun Microsystems Inc. in Mountain View, Calif., is the leader at the low end of the workstation price spectrum, the company is often the target of X-terminal makers. "No doubt about it, our biggest competitor is Sun," says NCD co-founder and executive vice president Judy Estrin.

Educating potential buyers is the biggest challenge for X-terminal makers. Beyond acquisition costs, for example, vendors pitch X terminals as cheaper than workstations to install and maintain, with lower training costs. And because they run off of central computers, X terminals offer better security and easier administration. Sun executives counter by saying that workstations provide more value for the dollar.

Multiplying X terminals

Worldwide sales of X terminals ($ millions)



*estimated

Source: International Data Corp.

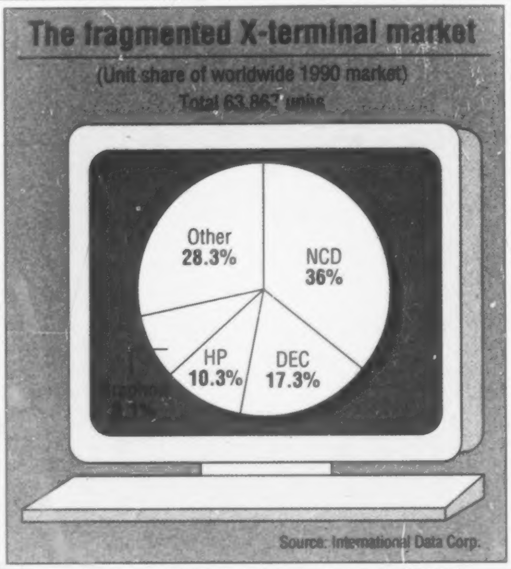
As for the major computer vendors like IBM and DEC, they tout X terminals as complementary to their other desktop devices. IDC's O'Brien explains that a broad product line provides a marketing advantage to those computer companies—some buyers want workstations *and* X terminals. Because many workstations offer more power than one user may ever need, some customers attach one or more X terminals to each workstation, turning it into a multi-user computer to reduce the per-user cost. IBM's Arthur says that most of his company's X terminals are sold as add-ons for its RS/6000 workstations.

Looking to the future, market optimists look for huge growth from user sites now dominated by dumb terminals used for graphics and even text applications. Dataquest estimates that in 1990 alone, some 6 million dumb terminals were sold worldwide, generating factory revenue of $4.5 billion. But so far, much of that lucre has eluded X-terminal vendors.

Prices, service, and a lack of appropriate software are the key obstacles to an explosion of X-terminal demand. A decline in X-terminal prices, to $750 or lower, is needed to convince dumb terminal buyers to switch. Furthermore, X terminals are not "plug-and-play"—they require more service and user training than standard terminals. And because the X Window System is predominantly used in scientific and engineering circles, there is a dearth of X window software for commercial applications.

Dataquest's Chang contends that real demand from commercial accounts is up to two years away, while IDC's O'Brien says that 1994 to 1995 is more realistic. "The commercial market is just starting to take off" for X terminals, notes David Laws, president of NCR's Applied Digital Data Systems subsidiary in Hauppauge, N.Y.

IN ADDITION TO the development of commercial software, broad-based distribution will be critical to the success or failure of the vendors. The majority of X-terminal sales are currently made directly to users—Tektronix recently sold 1,500 units to U.S. West Inc., for example. While the major com-



The fragmented X-terminal market

(Unit share of worldwide 1990 market)

Total 63,867 units

Source: International Data Corp.

puter companies will rely on their direct sales forces, smaller companies must line up other channels of distribution to take advantage of increased interest in X terminals.

NCD appears to have the advantage here because it has already assembled a solid stable of OEMs (original equipment manufacturers), including Motorola, Pyramid Technology, Mips Computer Systems, Data General, Solbourne Computer, Convex Computer, Bull HN, and others. Visual Technology has inked OEM deals with Kubota Computer of Japan and Stardent Computer, and the company is jointly developing a new X terminal with Intergraph, according to Visual Technology's Michael Braca, vice president of advanced marketing and technology.

A FEW COMPANIES have even taken the first steps toward volume shipments of X terminals through industrial distributors. Hewlett-Packard lined up Lex Electronics Inc. and Hall-Mark Electronics Corp. to carry its X terminals, says HP's Morse. But ADDS's Laws fears that X-terminal demand will have to grow for another 18 months to two years before industrial distributors become a viable channel.

While some observers say that a shakeout among X-terminal vendors is imminent, a more likely scenario is a continuation of the trench warfare that has characterized the market. Although Visual Technology and Human Designed Systems were among the first to enter the X-terminal market, they and other smaller vendors were shoved aside by IBM, DEC, Hewlett-Packard, and ADDS (see table).

Among the early entrants, only NCD has stayed ahead of the big computer makers. NCD remains the market leader, followed by DEC's Video, Image, and Printer Systems Business Group of Maynard, Mass., and Hewlett-Packard. Although Tektronix's market share remains relatively low—5.8% according to IDC—most observers expect the company to leverage its market position and expertise in graphics terminals and gain ground in the X-terminal market.

But all of these companies now face stiffer competition from Asian companies that have begun marketing X terminals recently. At the Xhibition trade show in San Jose in June, Asian companies unveiling new X terminals included Japan's Marubeni, Arche Technologies of Taiwan, and Samsung Electronics of Korea. They hope to duplicate the success Asian companies have had in the monitor, terminal, and clone personal computer markets by following the same strategy: Use the modest wage scales of offshore plants and volume manufacturing to produce low-cost products and quickly gain market share.

X terminals are caught in a heated price and performance competition with PCs and workstations

One industry observer points to a Taiwan government-industry consortium, now working to develop low-cost X terminals, as proof of the seriousness with which Asian companies are attacking the market. "They're going to be a threat, no doubt about it, particularly at the low end," says Tek's King.

But analysts and U.S. vendors say that the X-terminal market may not be as easy to penetrate with clones as was the case with personal computers. PCs are built around a single microprocessor architecture and operating system and so are easy to clone. "It may not be a challenge to build an X terminal," says Greg Blatnik, marketing vice president of the X-terminal division of Micronics Computers Inc., Fremont, Calif. "It is a challenge to build a good one."

What's more, service and support requirements for PCs are relatively simple. X terminals, on the other hand, are more sophisticated products that often operate in multivendor networks and so require more expertise to sell, service, and support. Asian manufacturers also lack the distribution channels required to successfully sell X terminals.

Despite the heated competition of the X-terminal market, vendors are buoyed by sales predictions: Dataquest estimates more than 860,000 units valued at over $1 billion in factory revenue worldwide in 1995, a sizable piece of the desktop market considering that 600,000 PCs and 2.2 million workstations will be sold that year for X Window applications.

"It is still an embryonic market," concludes NCD's Estrin. "But there is no longer any controversy over whether X terminals are a viable alternative." □

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FOR THE MANAGEMENT TEAM IN ELECTRONICS, COMPUTER, AND SYSTEMS COMPANIES—WORLDWIDE
AUGUST 19, 1991

AT&T Microelectronics bets a billion

PAGE 28

William J. Warwick, president of AT&T Microelectronics

Electronic Business

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AUGUST 19, 1991

Cover photo by Jeffrey Vock

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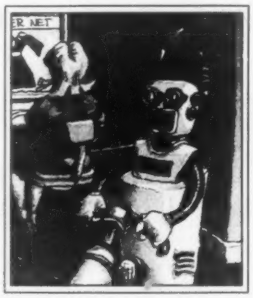

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INSIDE BUSINESS

How companies are learning hard lessons

WHAT DO marketing, capital spending, and industrial recycling have in common? Simply this: In all three areas, electronics companies are proving they can overcome their past errors.

Editorial assistant Quang Bao

Exhibit A is AT&T Microelectronics. The division stumbled badly a few years back as it tried to enter a major market, merchant semiconductors. False starts and a technology-first, market-last philosophy created a credibility crisis among potential customers. But as Teri Sprackland and Lewis Young report in our cover story, there have been major upgrades in market awareness at AT&T Microelectronics.

Those changes start at the top, with a new management team that defies AT&T tradition by tapping outside talent. Those new managers are working to create a corporate culture based on close ties with customers, both inside and outside AT&T's core communications businesses. That means asking customers' advice on product development and building trust among microelectronics prospects who compete with AT&T in other areas.

Now let's look at Exhibit B—"B" as in budgets and, specifically, as in budgets for capital spending. An exclusive ELECTRONIC BUSINESS ranking of the top 100 capital spenders in the U.S. electronics industry reveals a surprising trend: Despite declining profit growth in fiscal 1990, the top 100 increased investment in new plants and equipment. Furthermore, despite the impact of the current recession, electronics executives say they expect to boost capital spending next year.

Harder still, across all industries, has been the lesson of environmental responsibility. In Europe, companies are under special pressure to reduce pollution by recycling their products and the hazardous materials they contain. Senior editor Barbara Berkman provides an in-depth report on how the top European electronics companies are responding, with stateside reporting help from editorial assistant Quang Bao.

Vietnamese-born Quang is a recent addition to the ELECTRONIC BUSINESS staff. Along with canvassing U.S. electronics companies on environmental safety, he's done extensive research for articles on executive compensation and for our upcoming issue on quality. A recent Boston University graduate, he joins the staff as a recipient of a six-month Cahners President's Fellowship.

—John Parker

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SEMICONDUCTORS

Uncle Sam still rules the mixed-signal markets

DESPITE LOSS OF share in most other semiconductor markets, the Stars and Stripes are still flying high over the fast-growing mixed-signal chip market, according to a new report from VLSI Research Inc.

In sharp contrast to the Japanese-dominated memory chip markets, U.S. companies hold 6 of the top 10 places (including the top 5) on the 1990 VLSI rankings, says Gus Richard, market analyst at the San Jose-based firm. National Semiconductor, Texas Instruments, and Analog Devices, respectively, retained their top three places on the list from 1989; Motorola and Harris swapped fourth and fifth places, with Motorola's 34% annual sales growth leading the top 10.

Only two Japanese companies (not counting Japanese-owned, U.S.-run Silicon Systems Inc.) made the top 10 list. Silicon giants NEC and Toshiba each dropped a place in the list, falling to 7th and 10th, respectively. "We just don't see the Japanese in this market," Richard notes. "What little mixed-signal technology they do have is mostly for internal use."

The U.S. hold on the market is historical—the country has been in analog design for over 30 years—and analysts say it's unlikely to change soon. Most chip companies, especially in Japan, have focused on digital technology for years, leaving analog design to niche suppliers.

The growth in mixed signal is driven by the need for higher integration in systems that have traditionally used discrete analog and digital chips, notes Richard Sessions, director of marketing for analog/digital technology at National. Disk drives that used 100 chips a few years ago use just 16 today, for example, and will use only 4 by 1995.

Analog design is the key to the mixed-signal market, explains Sessions. "You need the heritage in analog to win in mixed signal," he says. "You can't go to Cornell and MIT and find people interested in learning analog." He adds that automated design tools, which have taken the mystery out of digital design, are about 10 years ahead of analog tools.

And the mixed-signal market will remain a good opportunity for U.S. manufacturers. With a compounded annual growth rate of over 20% through 1995, mixed-signal chips will outpace the overall semiconductor industry growth rate, says VLSI, offering hope for U.S. chip makers targeting growth markets such as fax machines, LANs, and hard-disk drives. VLSI predicts that the market for chips that combine analog and digital signals on the same chip will more than double, from $5 billion in 1991 to $10.6 billion by 1995.

A special advantage for U.S. chip companies selling into the disk drive markets is the fact that U.S. companies dominate the small-form-factor hard drive markets. "Almost all the chips are made for custom applications and then sold as standard parts," says VLSI's Richard. "It helps to be close to your customers when developing these application specific parts."

—Hugh G. Willett in San Jose

Top ten mixed-signal suppliers

($ millions)

1989 Sales	1990 Sales
National Semiconductor $340.6	National Semiconductor $426.1
Texas Instruments $321.8	Texas Instruments $394.5
Analog Devices $228.9	Analog Devices $271.6
Harris Semiconductor $163.6	Motorola $190.9
Motorola $142.9	Harris Semiconductor $185.0
NEC $134.3	Silicon Systems* $165.1
Silicon Systems* $124.4	NEC $148.8
Rockwell $123.0	Rockwell $140.4
Toshiba $121.0	GEC Plessey $138.6
SGS Thomson/ Microelectronics $109.7	Toshiba $131.5

*Silicon Systems is a U.S.-run company owned by TDK, a Japanese company.

Source: VLSI Research Inc.

INFORMATION SYSTEMS

Federal agencies to cope with five-year slump

IF YOU THINK planning your company's capital budget is easy during a recession, try working for the government.

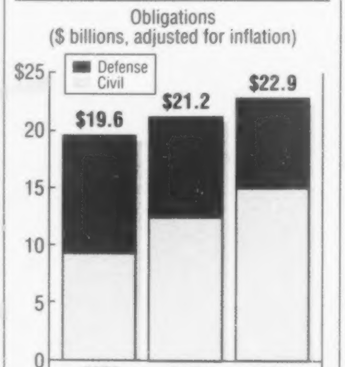
Despite ever-growing information needs, a cap on spending means slow growth ahead for government purchases of information systems. According to the Electronic Industries Association in Washington D.C., federal obligations for computers and other information-related hardware, software, and services will grow just 0.7% per year after adjusting for inflation, from $22.3 billion in fiscal 1992 to $22.9 billion in 1996. That growth rate is down from the trade association's previous five-year forecast of 1.5% annual growth for 1991 through 1995.

Many of the cuts will come in defense spending, but the civil sector is expected to hike spending for information systems 3% per year (after inflation) over the next five years. As a result, the top three buyers of information technology will be the Transportation Department, the Treasury Department, and NASA. Also, the amount of the federal information technology budget that will be spent on outside contractors is expected to grow nearly $1 billion over the next five years; by then, funds for contractors will represent 74% of total federal information systems spending.

George Shaw, director of planning for Hughes Information Technology Co. in Reston, Va., says there is another bright side to the EIA slow-growth forecast. "Since the forecast was released last spring, we've learned the FBI will be spending more on information systems for the National Crime Information Center and another program," he says. For vendors, of course, that's welcome news. For criminals, however, it may be another story.

—Elizabeth B. Baatz

How the government buys info systems



Source: Electronic Industries Association

RUGGEDIZED COMPUTERS

Codar patent stirs DOD computer market

HAS A SMALL Colorado company cornered the market for ruggedized computers?

Codar Technology Inc. of Longmont, Colo., has been awarded a patent covering "the general design concepts of ruggedized computers and workstations," according to the company. Ruggedized computers, built with special enclosures, ventilation systems, and shock-prevention gear, are designed for use in military vehicles, on factory floors, and in other harsh environments.

Ruggedized computers are a rapidly growing market, given that the Pentagon is buying more commercial computers adapted to military use instead of mil-spec computers designed specifically for military applications. This fiscal year, the U.S. Department of Defense is expected to buy more than $1.5 billion worth of commercial computers, of which ruggedized systems make up a sizable chunk.

Codar, with annual sales of $20 million, buys computers from Digital Equipment, Sun Microsystems, and Motorola, then rebuilds and sells them for use in missile-launching systems. Although Codar president Mike Evans says the patent "appears to be very broad" in scope, he declined to speculate on its impact on other ruggedized computer suppliers.

Vendors and industry-watchers are scratching their heads over the patent's potential impact. Builders of ruggedized computers range from such giants as Raytheon to smaller companies such as Rugged Digital Systems and Cyberchron. A Cyberchron spokesman says any impact will hinge on just how the patent defines ruggedized computers.

If the scope of the patent is as broad as Codar hints, "It could really turn into a nasty fight," says analyst Brett Lambert of Defense Forecasts.

Under law, companies that supply ruggedized computers to the military cannot be stopped from building those computers even if judged to be in violation of Codar's patent. But Evans says that those companies could be required to pay royalties to Codar for use of the patented design.

—Rick Whiting

STRATEGIES

Is Plessey/SGS alliance the prelude to merger?

GEC PLESSEY Semiconductors and SGS-Thomson Microelectronics have agreed on a joint development program for semicustom ICs—the first step in a continuing program for semiconductor research and development.

The alliance, announced last month in Paris, standardizes both the cell libraries and the 0.7-micron CMOS process of the two companies. Under the "precompetitive" agreement, the companies will share R&D costs but will not market jointly.

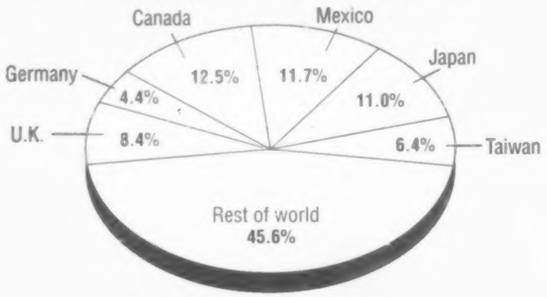
The intense price pressure of the ASIC market has many companies struggling to maintain margins. GPS and SGS-Thomson, in agreeing to divide research costs and standardize their process and cell libraries, have in one stroke halved their R&D expenses—a move that could improve both companies' competitiveness.

Both Doug Dunn, GPS managing director, and Philippe Geyres, corporate vice president and general manager of SGS-Thomson's programmable products group, alluded to recent comments by Pasquale Pistorio, president and CEO of SGS-Thomson, about the desirability of his company's merger with another European semiconductor company. Both executives, however, denied that merger discussions were under way.

GPS is adopting SGS-Thomson's

Offshore buyers helped sales last year...

U.S. exports of communications equipment by market

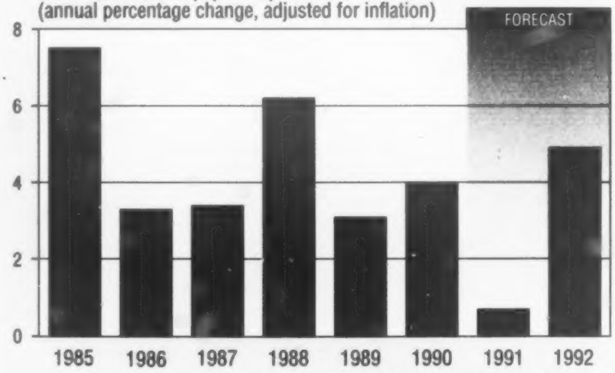


Total exports in 1990 = $6.8 billion

Source: Electronic Industries Association

...and U.S. buyers promise an even better '92...

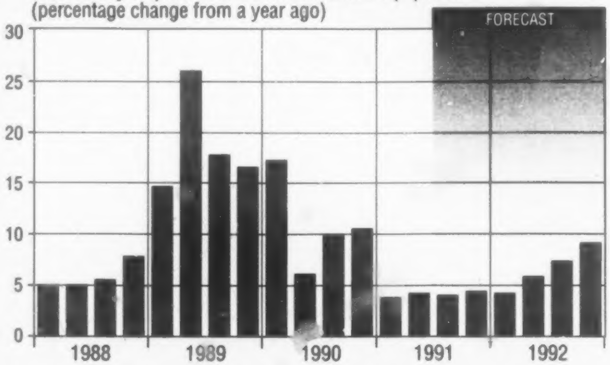
Communications equipment purchases (annual percentage change, adjusted for inflation)



Source: Commerce Dept.; forecast: Cahners Economics

...which bodes well for industry shipments

U.S. factory shipments of communications equipment (percentage change from a year ago)



Source: Commerce Dept.; forecast: Cahners Economics

Communications equipment sidesteps the recession

LOW BUSINESS confidence during the Persian Gulf crisis took its toll on capital-spending plans, including purchases of communications equipment. In the first quarter of this year, U.S. business doled out an annualized $51.3 billion for communications equipment—a 1.6% increase from a year ago. That measly increase shrivels up once inflation is taken into account. In constant dollars, investment amounted to $38.7 billion, a drop of 1% relative to first-quarter 1990.

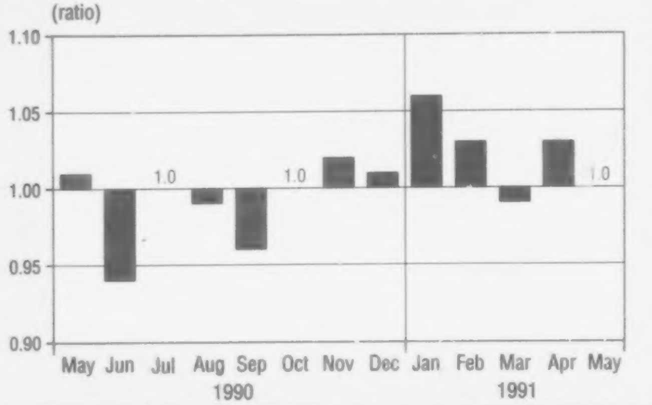
More recently, however, higher sales, improved profits, and an easing of the credit crunch should mean a return to more moderate investment growth in communications equipment. So do not expect a repeat of the retrenchment that took place during the recession of 1982 and 1983, when inflation-adjusted purchases of communications equipment declined from year-ago levels for seven consecutive quarters. This time around, Cahners Economics expects slow but increasing growth for U.S. business investment in communications through early 1993.

Nevertheless, U.S. manufacturers can expect to feel at least a moderate pinch because of fewer offshore sales. Last year, total exports of communications equipment came in at $6.8 billion. Both Canada and Britain have fallen on hard times lately, however, and economic growth has slowed even in Japan and Germany. Furthermore, the U.S. dollar's sharp gain since the beginning of the year could crimp exports for a while.

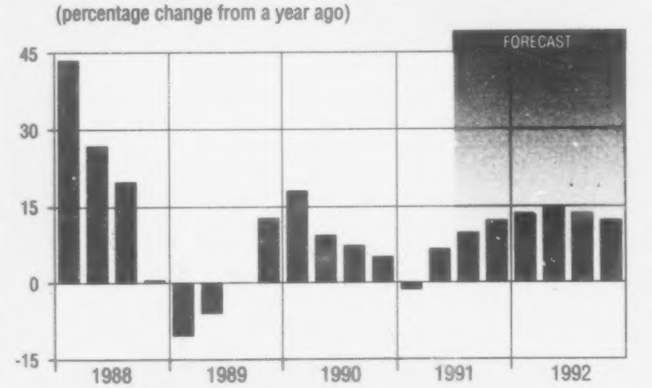
Due to a lagged response to the early 1991 recession, U.S. factory shipments of communications equipment are expected to increase by only 4.1% this year, on the heels of a robust 10.8% rise in 1990. Next year, shipments will grow 6.6% as the recovery takes hold.

—By Madeline Franchi

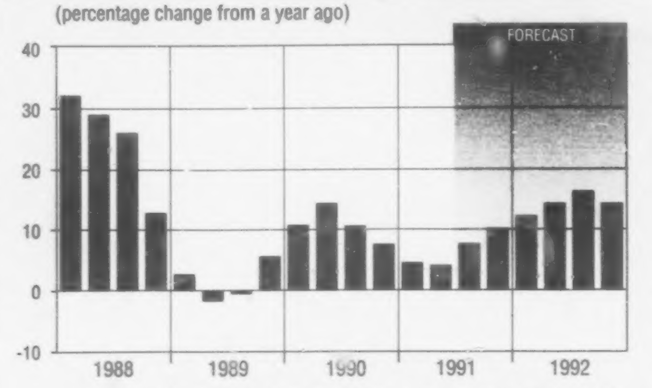
Distribution's book-to-bill lingers low...



...but optimistic second-quarter bookings...



...suggest better billings growth ahead



Note: Second quarter figures are estimates based on two months of actual data.

Source: National Electronic Distributors Association; forecast: Cahners Economics

Distribution forecast still looking relatively rosy

AFTER A FEW years of speculating if and when the recession would start, forecasters can turn to a more gratifying chore: Identifying the beginning of the next expansion. Getting enough sectors of the economy over the recessionary hump so the overall economy can grow steadily again has been an agonizing process. Unlike the harder-hit financial and housing industries, however, the electronics distribution industry has managed to stay afloat.

So far distributors have held onto a steady 4% shipments growth rate in the first half of 1991. Even though the book-to-bill ratio for the nation's largest distributors hasn't risen lately to an acceptable comfort level, neither has the ratio fallen through the floor.

After slipping 1.3% in the first quarter of 1991 compared with the year-ago level, distributors' bookings rebounded with 9.3% year-ago growth in April and a 6.1% gain in May. In fact, Cahners Economics expects distributor orders to see encouraging gains during every remaining quarter this year and next.

Shipments also expanded at a 7.1% rate above year-ago levels in May 1991 (the highest year-ago growth rate in the past five months). It appears that the low point for shipments growth occurred in the second quarter of this year. A few more months of positive data this fall should confirm the trend. The distribution billings forecast remains unchanged at 6.5% for 1991. We're more optimistic about distribution in 1992 and predict a 14% growth rate for the year.

—By Julie Handelman

For more information on Cahners Economics' forecasting services, contact Dan Buchan at (617) 630-2105 or by fax at (617) 630-2100; or write Cahners Economics, 275 Washington St., Newton, MA 02158

TOP
100
CAPITAL
SPENDERS

Capital spending holds on

Even with the recession, the top spenders did alright in 1990 and plan to invest big bucks in '92

By Elizabeth B. Baatz and Linda Stallmann

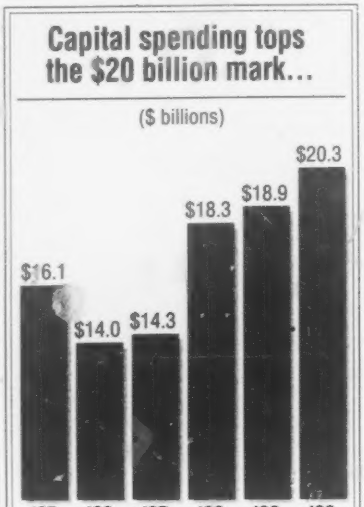
When profits plummeted in the 1985 recession, capital-spending budgets for the top 100 capital spenders in the electronics industry jackknifed too. Not this time. Saved by a surge in fiscal 1990 profits, the double-digit profits drop in 1989 failed to seriously cut into capital budgets.

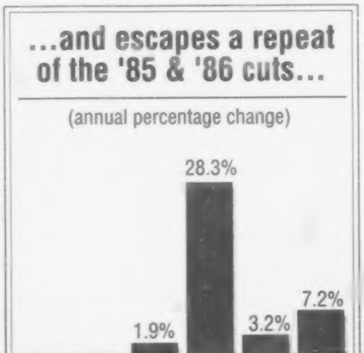
In fact, capital investment's by the top 100 spenders rose 7% in fiscal 1990, to a record-breaking $20.3 billion in nominal dollars. Excluding IBM (which accounted for nearly one of every three dollars spent by the top 100), capital spending actually jumped 10%. Last year's gain followed on the heels of a mere 3% rise in capital spending growth and a 27% profit slide in 1989.

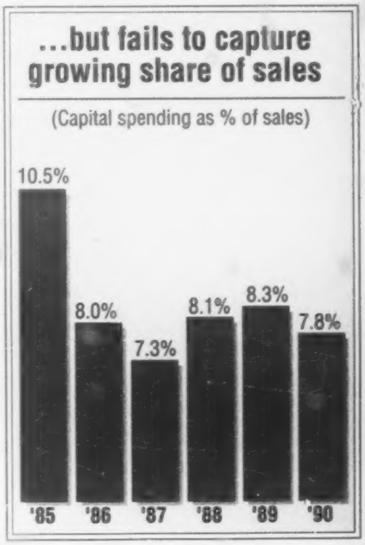
Another reason capital spending did not contract in 1990 was simple necessity. Even with a 4% decline in sales during 1990, for example, components manufacturer CTS Corp. still managed to increase capital spending by 9%. The total quality movement led the Elkhart, Ind., company to reevaluate factory layouts for efficiency and the need to broaden its foreign presence drove CTS to invest in new factories abroad. While CTS was an exception to the rule—most companies with falling sales cut back capital spending—the 63 companies that increased their capital spending budgets in 1990 more than offset the 37 companies that cut them.

But not all trends are up. While dollars committed to new plant and equipment continued to grow last year, capital spending as a percentage of total sales for the 100 top spenders receded to 7.8% last year, from 8.3% in 1989 and from a peak 11.2% spending-to-sales ratio in 1984.

HOW MEANINGFUL are these capital spending-to-sales ratio trends? The sensationalist may imply that a falling ratio demonstrates that short-sighted U.S. companies are not investing in adequate capital equipment for the future. And compared with Japan, the numbers don't look good. According to Lawrence Krohn, senior economist for Shearson Lehman Hutton in New


Capital spending tops the $20 billion mark...


...and escapes a repeat of the '85 & '86 cuts...


...but fails to capture growing share of sales

Source: ELECTRONIC BUSINESS

Some industries keep investing, others cut back

Industry (number of companies)	Capital expenditures in fiscal 1990 as % of sales	$ millions	% change from 1989
Semiconductors (12)	13.6%	$3,631.2	8.5%
Communications (9)	10.4	1,458.2	8.2
Components (7)	9.9	526.6	-1.9
Mainframes (10)	8.7	7,908.8	-0.4
Minicomputers (6)	8.3	1,608.3	-10.6
Diversified (7)	8.3	8,404.3	2.8
Software (10)	7.6	456.2	22.0
Computer-based systems (4)	7.1	1,007.9	2.4
Government (10)	6.8	2,741.8	46.2
Desktop computers (5)	6.7	871.2	-9.8
Medical equipment (5)	6.3	170.5	36.2
Peripherals (7)	5.9	425.3	15.0
Office equipment (3)	4.7	803.0	6.6
Instruments (7)	4.3	466.6	-1.8
Consumer (2)	2.5	144.9	-7.5
Distribution (3)	1.7	49.1	NA

Note: Some companies are included in more than one industry. See main tables for categorization of each company NA = Not available

Source: ELECTRONIC BUSINESS

York, Japan spent roughly 20% of its GNP on machinery and equipment last year, while U.S. industry spent just 12%. Comparisons between the U.S. and Asian electronics industries look just as bad.

While the U.S.-Japan capital-spending gap continues to receive attention, there is little focus on the end result of all those dollars and yen spent. The bottom line, however, for all this capital equipment investment is to improve one's competitive position in order to reap more profits down the road. The top 100 U.S. electronics company capital spenders did manage to hike their profits 26% collectively in fiscal 1990, while increasing capital budgets at the same time. Profits from all top 200 U.S. electronics companies, which include a significant share of non-electronic operations for many conglomerates, actually fell slightly in calendar 1990.

Steve Pavlech, manager of technology planning for Hamilton Standard, a division of United Technologies in Windsor Locks, Conn., points out that the interpretation of capital spending-to-sales ratios is changing. For example, says Pavlech, "companies like Hamilton Standard are scrutinizing working capital very hard to make sure they get maximum effectiveness for every dollar spent." As electronics companies improve the way they utilize their funds, including using more industry consortia and tapping into federal dollars for improving manufacturing technology, the capital spending-to-sales ratio could be falling partly because each dollar is being spent more wisely.

THE BIG SPENDERS in the electronics industry, of course, are semiconductor companies. According to ELECTRONIC BUSINESS's ranking of the top 100 spenders, the 12 semiconductor companies on the list spent a collective $3.6 billion in fiscal 1990, or 13.6% of their sales, on capital equipment. Despite a cut in spending by 5 companies—including National Semiconductor and Micron Technology—the group increased capital spending a respectable 8.5% last year. Overall, chip makers spend more money on plant and equipment for every sales dollar generated than any other segment of the electronics industry.

Other industry segments that have been accelerating equipment purchases include military and government electronics suppliers, medical equipment makers, software, and peripherals companies. The latter three make sense, as these segments have the best sales growth to support their expansion.

In the government sector, a 46%

The biggest budgeters

(% of sales)

Advanced Micro Devices	28.7%
Micron Technology	24.0
Applied Materials	19.6
Sequent Computer	19.0
Intel	17.3
Integrated Device	16.7
Cypress Semiconductor	16.2
Tandem Computers	16.1
Teradata	15.3
Pyramid Technology	14.3

Source: ELECTRONIC BUSINESS

The smallest budgeters

(% of sales)

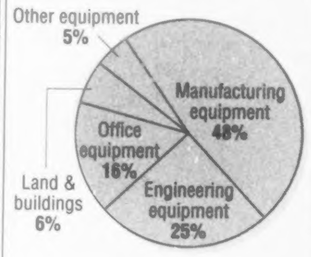
Avnet	1.0%
Perkin-Elmer	1.7
Computer Associates	1.8
Control Data	2.3
Zenith Electronics	2.3
Premier Industrial	2.3
Tandy	2.5
Marshall Industries	3.1
Xerox	3.3
ESCO Electronics	3.3

Source: ELECTRONIC BUSINESS

gain in capital spending from 1989 to 1990 is slightly deceptive because two large companies, Raytheon and Litton Industries, which were excluded from the ELECTRONIC BUSINESS ranking in past years, were added to the capital spending ranking for the first time this year. (The methodology note below explains why.) Still, the need to invest in new environmental controls and intense competition in a shrinking military market explain much of the defense sector's increasing capital budgets.

Where are the dollars going?

(Capital spending in 1991 by U.S. electronics companies)



Source: ELECTRONIC BUSINESS

Chances are, because capital spending typically lags a recession, plans for increasing capital budgets have been curtailed somewhat in early 1991. Next year's exclusive ELECTRONIC BUSINESS ranking of the top 100 capital spenders in the U.S. electronics industry will chronicle those results. Evidence from the U.S. Commerce Department on capital expenditures by all industries shows a spending slowdown has been in effect so far this year.

Anecdotal evidence suggests that the recession did not hit capital budgets in 1990 but will impact spending in 1991 as well. Take the case of Chestnut Ridge, N.Y.-based instrumentation maker LeCroy Corp. Says LeCroy's chief financial officer and vice president of finance, Joseph J. Migliozzi, "This recession sort of snuck up on us. In the past when we saw a recession coming, we could throttle back on capital spending and other spending. This time we took longer to react and were a bit late in turning spending off."

Looking forward, a special survey of 46 financial officers in the electronics industry shows that spending plans for 1992 are full steam ahead. According to the ELECTRONIC BUSINESS survey, these CFOs expect to pump up collective capital spending budgets by 28%, from an average $3.8 million in 1991 to $4.8 million in 1992. As a percentage of sales, capital spending is budgeted to increase from 5.8% to 6.7%.

Capital spending was a driving force in the latter part of the last economic boom in 1988 and 1989 and will continue to be the engine to growth in the next upswing. Even though the upcoming recovery is expected to be mild by historical standards, capital spending growth should outrace overall economic growth. One reason for the need to continue investing in plant and equipment is competitive pressure from abroad. In fact, half of all the dollars spent on plant and equipment by those CFOs polled by ELECTRONIC BUSINESS are buying manufacturing equipment. Also, a third of these companies are investing in foreign operations, particularly in Western Europe, as they gear up for the unified European market.

Still, not everyone is buying capital equipment to compete in the high-tech wars of the future. One CFO in the survey admits that an office manager at the company has put in a request for an old-fashioned typewriter. So much for all that high-brow PC software! For the rest of the industry, increasing capital spending regardless of weak sales will continue to be an overriding challenge. □

This ranking of the top 100 capital spenders includes those publicly owned companies from the ELECTRONIC BUSINESS 200 list that spend the most money on capital investments and that also generate 50% or more of their total revenue from electronics sales. In previous years, the top capital spenders had to generate 70% or more of their total revenue from electronics to be included in the top spenders list. The latest data have been gathered from company annual reports for fiscal 1990.

The biggest spenders

($ millions)	
IBM	$6,509
Motorola	1,256
Digital Equipment	1,028
Hewlett-Packard	955
Texas Instruments	909
GM Hughes Electronics	884
Intel	679
Unisys	460
Xerox	444
NCR	402

Source: ELECTRONIC BUSINESS

The biggest gainers

(% rise from 1989)	
Cadence Design	241%
Chips and Technologies	175
Quantum	161
Applied Materials	159
Marshall Industries	141
Pyramid Technology	137
Sequent Computer	127
Diebold	124
Western Digital	122
Tandem Computers	122

Source: ELECTRONIC BUSINESS

The biggest decliners

(% drop from 1989)	
Perkin-Elmer	74.6%
Micron Technology	59.9
Wang Laboratories	49.0
Ashton-Tate	47.5
LSI Logic	45.9
Sprague Technologies	44.8
Control Data	44.2
M/A-Com	38.8
Measurex	38.1
Cray Research	36.8

Source: ELECTRONIC BUSINESS

TOP 100

CAPITAL SPENDERS

Rank 1990	Rank 1989	**Company/** Location	1990 capital expenditures	% change from 1989	Capital expenditures as % sales	Fiscal year	Industry segments
1	1	**IBM** Armonk, N.Y.	$6,509.0	1.5%	9.4%	12/90	mainframes, diversified
2	3	**Motorola** Schaumburg, Ill.	1,256.0	14.8	11.5	12/90	communications, semiconductors
3	2	**Digital Equipment** Maynard, Mass.	1,027.6	-16.0	7.9	6/90	minicomputers
4	5	**Hewlett-Packard** Palo Alto, Calif.	955.0	11.4	7.2	10/90	diversified, computer-based systems
5	4	**Texas Instruments** Dallas	909.0	5.4	13.8	12/90	semiconductors, government
6	6	**GM Hughes Electronics** Detroit	884.3	36.4	7.5	12/90	government
7	9	**Intel** Santa Clara	679.5	61.0	17.3	12/90	semiconductors
8	7	**Unisys** Blue Bell, Pa.	460.1	-25.2	4.6	12/90	mainframes
9	8	**Xerox** Stamford, Conn.	444.0	1.8	3.3	12/90	office equipment
10	10	**NCR** Dayton	402.0	-4.5	6.4	12/90	mainframes, diversified
11	—	**Raytheon** Lexington, Mass.	390.7	-5.6	4.2	12/90	government
12	17	**AMP** Harrisburg, Pa.	338.4	34.2	11.1	12/90	components
13	11	**Compaq Computer** Houston	324.9	-11.6	9.0	12/90	desktop
14	13	**Pitney Bowes** Stamford, Conn.	322.7	7.7	10.1	12/90	office equipment
15	21	**Advanced Micro Devices** Sunnyvale, Calif.	304.2	91.6	28.7	12/90	semiconductors
16	12	**Amdahl** Sunnyvale, Calif.	303.9	-0.5	14.1	12/90	mainframes
17	22	**Tandem Computers** Cupertino, Calif.	301.3	121.6	16.1	9/90	minicomputers
18	16	**Honeywell** Minneapolis	251.5	-6.2	4.0	12/90	diversified, instruments
19	18	**Apple Computer** Cupertino, Calif.	224.3	-6.1	4.0	9/90	desktop
20	19	**Sun Microsystems** Mountain View, Calif.	212.9	4.0	8.6	6/90	desktop
21	25	**Harris** Melbourne, Fla.	193.2	94.5	6.3	6/90	diversified, government
22	—	**Litton Industries** Beverly Hills, Calif.	191.2	-23.3	3.7	7/90	government
23	15	**National Semiconductor** Santa Clara	182.0	-34.4	10.9	5/90	semiconductors
24	85	**Microsoft** Redmond, Wash.	158.1	76.9	13.4	6/90	software
25	14	**Wang Laboratories** Lowell, Mass.	152.8	-49.0	6.1	6/90	minicomputers
26	23	**Tandy** Ft. Worth	112.5	-8.1	2.5	6/90	consumer
27	48	**Applied Materials** Santa Clara	111.1	158.6	19.6	10/90	semiconductor equipment
28	33	**Seagate Technology** Scotts Valley, Calif.	102.4	31.1	4.2	6/90	peripherals
29	30	**Tektronix** Beaverton, Ore.	97.1	13.1	6.9	5/90	instruments & measurement
30	37	**Conner Peripherals** San Jose	94.7	44.0	7.1	12/90	peripherals
31	32	**Oracle Systems** Redwood Shores, Calif.	89.3	13.1	9.2	5/90	software
32	52	**Western Digital** Irvine, Calif.	86.5	122.1	8.1	6/90	peripherals
33	28	**Data General** Westboro, Mass.	85.1	-7.0	7.0	9/90	minicomputers
34	20	**Micron Technology** Boise, Idaho	79.8	-59.9	24.0	8/90	semiconductors
35	34	**Intergraph** Huntsville, Ala.	79.6	7.5	7.6	12/90	desktop
36	27	**Molex** Lisle, Ill.	72.7	-22.6	12.2	6/90	components
37	44	**DSC Communications** Plano, Tex.	68.1	34.8	13.1	12/90	communications
38	43	**Beckman Instruments** Fullerton, Calif.	67.3	33.3	8.3	12/90	medical equipment
39	26	**Cray Research** Eagan, Minn.	62.7	-36.8	7.8	12/90	mainframes
40	42	**SCI Systems** Huntsville, Ala.	62.7	23.7	5.3	6/90	contract manufacturing
41	24	**LSI Logic** Milpitas, Calif.	62.0	-45.9	9.5	12/90	semiconductors
42	49	**Loral** New York	61.2	51.0	4.8	3/90	government
43	38	**E-Systems** Dallas	60.2	6.2	3.3	12/90	government
44	45	**Storage Technology** Louisville, Colo.	59.4	17.7	5.2	12/90	peripherals
45	4[illegible]	**Medtronic** Minneapolis	55.3	7.7	6.6	4/90	medical equipment
46	[illegible]	**Varian Associates** Palo Alto, Calif.	54.9	12.2	4.3	9/90	diversified, instruments
47	36	**Lotus Development** Cambridge, Mass.	51.6	-25.1	7.5	12/90	software
48	—	**Sequent Computer Systems** Beaverton, Ore.	47.3	127.4	19.0	12/90	mainframes
49	57	**Maxtor** San Jose	44.7	52.8	9.1	3/90	peripherals
50	53	**Applied Magnetics** Goleta, Calif.	39.9	2.8	10.8	9/90	components

TOP 100 CAPITAL SPENDERS

Rank		Company/Location	1990 capital expenditures	% change from 1989	Capital expenditures as % sales	Fiscal year	Industry segments
1990	1989						
51	35	**Control Data** Minneapolis	$38.6	-44.2%	2.3%	12/90	mainframes, diversified
52	41	**Analog Devices** Norwood, Mass.	38.2	-25.2	7.9	10/90	semiconductors
53	56	**Cypress Semiconductor** San Jose	36.6	11.3	16.2	12/90	semiconductors
54	—	**Savin** Stamford, Conn.	36.3	59.5	9.6	12/90	office equipment
55	50	**VLSI Technology** San Jose	35.3	-10.6	10.9	12/90	semiconductors
56	63	**Integrated Device Technology** Santa Clara	35.0	31.7	16.7	3/90	semiconductors
57	51	**Mentor Graphics** Wilsonville, Ore.	34.9	-11.1	8.0	12/90	software
58	71	**Teradata** El Segundo, Calif.	34.4	77.9	15.3	6/90	mainframes
59	55	**Zenith Electronics** Glenview, Ill.	32.4	-5.0	2.3	12/90	consumer
60	65	**Vishay Intertechnology** Malvern, Pa.	30.9	29.9	6.8	12/90	components
61	67	**Silicon Graphics** Mountain View, Calif.	29.6	27.1	7.1	6/90	desktop
62	47	**Novell** Provo, Utah	28.1	-35.0	5.7	10/90	software
63	54	**Stratus Computer** Marlborough, Mass.	27.4	-25.9	6.8	12/90	minicomputers
64	78	**Scientific-Atlanta** Atlanta	27.4	75.6	4.5	6/90	communications
65	—	**Pyramid Technology** Mountain View, Calif.	25.8	136.5	14.3	9/90	mainframes
66	66	**3Com** Santa Clara	25.8	8.7	6.1	5/90	communications
67	75	**Andrew** Orland Park, Ill.	25.2	54.5	6.9	9/90	communications
68	—	**Convex Computer** Richardson, Tex.	25.1	64.0	12.0	12/90	mainframes
69	59	**Teradyne** Boston	23.9	-15.4	5.2	12/90	instruments & measurement
70	69	**Computer Associates** Garden City, N.Y.	22.8	1.7	1.8	3/90	software
71	96	**Diebold** Canton, Ohio	22.2	123.9	4.7	12/90	computer-based systems
72	—	**Cadence Design Systems** San Jose	22.2	241.1	9.6	12/90	software
73	—	**Autodesk** Sausalito, Calif.	21.1	56.7	8.9	1/91	software
74	87	**Archive** Costa Mesa, Calif.	21.0	66.8	7.2	9/90	peripherals
75	82	**Westmark International** Seattle	19.1	36.2	3.9	12/90	medical equipment
76	73	**Augat** Mansfield, Mass.	17.9	-0.6	6.0	12/90	components
77	—	**ESCO Electronics** St. Louis	17.6	-19.1	3.3	9/90	government
78	58	**M/A-Com** Burlington, Mass.	17.5	-38.8	4.7	9/90	government
79	68	**Avnet** Great Neck, N.Y.	17.4	-22.9	1.0	6/90	distribution
80		**Marshall Industries** El Monte, Calif.	17.0	140.5	3.1	5/90	distribution
81	89	**Watkins-Johnson** Palo Alto, Calif.	16.8	42.1	5.4	12/90	government
82	—	**Acuson** Mountain View, Calif.	16.7	20.8	5.9	12/90	medical equipment
83	—	**Quantum** Milpitas, Calif.	16.7	160.7	3.7	3/90	peripherals
84	99	**Ultimate** East Hanover, N.J.	16.5	75.8	7.9	4/90	software
85	64	**Measurex** Cupertino, Calif.	15.5	-38.1	5.8	11/90	computer-based systems
86	61	**Sprague Technologies** Stamford, Conn.	15.3	-44.8	4.9	12/90	components
87	81	**Symbol Technologies** Bohemia, N.Y.	15.3	8.2	6.6	12/90	computer-based systems
88	76	**Dynatech** Burlington, Mass.	15.0	-5.6	3.5	3/90	communications
89	—	**Premier Industrial** Cleveland	14.6	11.6	2.3	5/90	distribution
90	39	**Perkin-Elmer** Norwalk, Conn.	14.4	-74.6	1.7	7/90	instruments & measurement
91	86	**Concurrent Computer** Tinton Falls, N.J.	14.2	11.8	4.2	6/90	minicomputers
92	97	**ADC Telecommunications** Minneapolis	13.7	43.1	5.3	10/90	communications
93	77	**Datapoint** San Antonio	13.7	-13.0	5.1	7/90	communications
94	—	**Chips and Technologies** San Jose	13.5	175.2	4.6	6/90	semiconductors
95	80	**Tellabs** Lisle, Ill.	13.4	-6.1	6.3	12/90	communications
96	—	**Esterline** Bellevue, Wash.	13.4	80.2	3.4	10/90	instruments & measurement
97	100	**Diasonics** Milpitas, Calif.	12.1	29.8	4.5	12/90	medical equipment
98	92	**CTS** Elkhart, Ind.	11.8	9.0	4.7	12/90	components
99	70	**Ashton-Tate** Torrance, Calif.	11.7	-47.5	5.1	12/90	software
100	94	**Fluke** Everett, Wash.	11.4	8.7	4.9	9/90	instruments & measurement

Home automation finally arrives

New protocols will help chip makers and other electronics suppliers tap into what some see as a $5 billion-plus market

By Barbara Jorgensen

After a long string of costly, time-consuming false starts, home automation is here.

The vision, according to HA developers, goes something like this: The harried homeowner rushes off to work, leaving the coffee maker on, the VCR unprogrammed for that daytime show, and the security system deactivated. But once at work, she can use a touch-tone phone to turn off the coffee maker—(if it's not already programmed to do so), activate the VCR and security system, and even program the air conditioner to have the house at a pleasant 72 degrees by 6 P.M. The "smart house" might also turn off the lawn sprinkler in the event of rain and run the dishwasher once the laundry is finished.

Prototypes of such homes, backed by several partnerships and organizations, already exist. But by the end of this year—for the first time since the smart house was envisioned a decade ago—several new protocols will bring an unprecedented level of automation to existing and future homes, apartments, and industrial buildings. "Home automation is closer to reality than ever before," says Bill Scheffler, president of the Home Automation Association in Washington, D.C., and national marketing manager for X-10 (USA) Corp., in Newark, N.J.

Reaping many of the rewards of

SHOPPER NET
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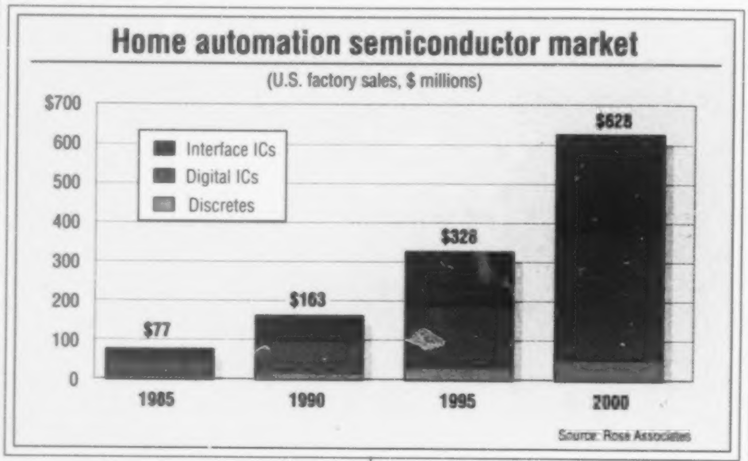
DOOR
T.M. Barrett



Home automation semiconductor market

(U.S. factory sales, $ millions)

Source: Rose Associates

the smart house will be semiconductor makers such as Texas Instruments, Motorola, and Toshiba. But payoffs also will flow to manufacturers of electrical and electronic components, control devices, security systems, computer hardware and software, communications equipment, and appliances.

THE RESULT: a $5.6 billion market for HA-compatible equipment by the year 2000, predicts Rose Associates, a Los Altos, Calif.-based market research firm. That figure includes hardware and software products for multifunction control systems, user interfaces such as phones and TVs, and communication networks, as well as subsystem markets for security and environmental-control products and services. Researchers at New York-based Frost and Sullivan Inc. predict that annual growth rates of HA-related products will rise from 1.2% last year to 35.4% by 2000.

Does that mean, as some suggest, that HA could create a new generation of consumer electronics for U.S. companies that have lost out to foreign competitors? "I think that is too optimistic," says Scheffler. "Whatever happens in the United States in terms of home-automation standards will be repeated by the Japanese. Or they'll come in with their own standard. Regardless of which protocol is used, the Japanese will still be building the equipment" because of their strong presence in consumer electronics and more economical manufacturing abilities. Other sources expect to see much of the HA chip manufacturing eventually move offshore as well.

While much of the technology behind HA has been around for years, the market has so far languished for several reasons: high prices, insufficient applications, the lack of a dominant player to provide financial backing and marketing expertise, and a paucity of standards.

That last obstacle will fall in November, when three new protocols—the Electronic Industries Association's Consumer Electronics Bus (CEBus), Smart House L.P.'s Smart House, and Palo Alto Calif.-based Echelon Corp.'s LonWorks—will join X-10, today's de facto HA standard. Although X-10 dates back to 1978, it is a one-way "plug-and-play" communication system; X-10 manufactures the Protector Plus security system, for instance, which can be installed by the consumer. The other three protocols are so-called enabling technologies that allow products and systems to communicate with one another on varying levels. The new protocols are targeted to U.S. markets; Europe and Japan have separate HA standards.

Part of Echelon's system (LonBuilder, the tools to build LonWorks applications) began shipping in April; half of CEBus's media specs have been released, and Smart House's "Smart Ready" wiring spec is due this month. The Smart House protocol is expected to be the standard for thousands of the million or so new U.S. homes built annually, according to Rose Associates. With the protocols now public, it is up to equipment manufacturers to develop products around one or all of them. The protocols are all incompatible, although not necessarily proprietary—both Smart House and Echelon offer licensing agreements with their technologies, so products can be manufactured for those systems. (LonTalk, part of Echelon's LonWorks package, is actually the protocol.)

Protocol developers paint a rosy picture of the market once the HA concept catches on and target markets go far beyond home buyers. Echelon, in fact, is now targeting OEMs in lighting and building and industrial automation—early customers include Allen-Bradley, Johnson Controls, and Leviton Manufacturing—as well as developing "intelligent" products for the home. AT&T Consumer Products is looking at LonWorks toward that possibility, according to G. H. Hickox, new business director.

IN ADDITION TO X-10, the HA market is now supplied by 20 to 30 vendors, mostly small companies that offer proprietary control and communications systems and integrate them with commercial components and systems. One emerging player is Group Three Technologies in Simi Valley, Calif., which just unveiled its Samantha system for controlling communications, lighting, appliances, security, and other functions. Square D and CSI/Carrier have also released HA systems; Square D's Elan Advanced Home Network, for example, is targeted at integrating home entertainment systems.

The four protocols are divided between two kinds of control—a centralized control system, with the system's "brain" in one location, and intelligent distributed control, in which systems are interconnected but the failure of one will not affect the others. X-10 and Smart House are centrally controlled; CEBus and Echelon use distributed control. All can be implemented in varying stages, in entire buildings or parts thereof. Once the protocols are in place, appliances can be added selectively.

Regardless of how simple or sophisticated they happen to be, HA systems will depend heavily on semiconductors. Rose Associates predicts that the market for those chips—including discretes, interface ICs, and digital ICs—will grow from $163 million in 1990 to $328 million by 1995 and then nearly double again to $628 million by 2000.

ONE EXAMPLE IS the Neuron chip developed for Echelon by Motorola and Toshiba; capable of communications and control, it could be used in anything from consumer electronics to sprinkler systems. Texas Instruments has a CEBus-compatible chip and is also designing ICs for Smart House. CyberLynx Computer Products in Boulder, Colo., is working with TI on a single-chip CEBus interface that will handle all the details of CEBus communications. And AISI Research Corp. is reportedly shipping early versions of a similar chip called Spirit, an "intelligent" chip that can operate without additional processor power.

The manufacture of HA chips will, for the most part, stay in the United States for at least five years, predicts Rose analyst Doug Schliebus, partly because of protocol differences between the United States and Japan. Future applications for HA chip makers include modems, microcontrollers, and triacs (three-terminal semiconductors with on-off switching capability) for use in HA appliances.

While HA technology is driven largely by semiconductors, virtually every other segment of the electronics industry will get into the act as well. Leading U.S. connector manufacturers Amp Inc. and Molex Inc., for example, are developing wiring, modules, switches, cabling, and connectors for Smart House. Dick Pierce, director of Molex's electronic systems business unit in Lisle, Ill., says licensing by Smart House does not prevent Molex—or any manufacturer—from producing to the CEBus or any other HA protocol. "From our standpoint, the emerging protocols are a tremendous opportunity," says

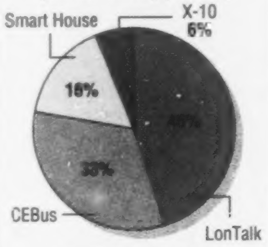
A guide to home automation protocol

CEBus: An open standard being developed by the EIA's Consumer Electronics Group. Its final form is scheduled for release in November and includes specifications for automating a home through five media: power lines, radio frequency, infrared, telephone wiring, and twisted-pair wiring. Its aim is to be retrofittable, have no central brain, and be non-product-specific and expandable. Market: apartments, existing homes. Wiring for CEBus in a 2,400-square-foot home would cost about $700.

- **Smart House:** A for-profit limited partnership funded in part by the National Association of Home Builders and undergoing an initial public offering. Smart House currently is geared toward new-home construction. Functions will be controlled by a central brain. All products must be Smart House-compatible. Licensed companies will build Smart House products to be marketed and tested by Smart House. Non-Smart House appliances will have basic on-off capability but will not be able to communicate. Additional new home cost: $7,000 to $10,000.
- **LonWorks:** A set of technological tools from Echelon Corp. that includes the LonTalk protocol, its Neuron chip, LonWorks transceivers, and LonBuilder hardware and software tools. Similar to CEBus in not needing a brain. Echelon's target market is OEMs that can use the tools to write applications programs, develop a network, work with the protocol, and embed it into the application. It is also usable in Japan and Europe. With a price tag of $14,000 for LonBuilder alone, the entire LonWorks package is expensive; it targets OEMs in building controls, factory automation, commercial lighting, consumer products, and office automation.
- **X-10:** Established in 1978, currently the de facto HA standard. A simple "plug-and-play" system, X-10 uses a controller and module system. The lowest-priced solution to home automation so far. X-10 (USA) Corp., an OEM engineering and design company, has designed products for General Electric, Advanced Control Technology, Leviton, and Tandy. X-10 is upgrading its offering to smarter products and will eventually offer intracommunications ability.
- **Non-U.S.:** Japan has HBS and Europe D²B. Representatives from Europe, Japan, and the United States are working toward an international home automation standard. ☐

Who will control the smart home?

(market share by protocol)



Total market by 2000: $1.6 billion

Source: Rose Associates

Pierce. "Molex has to be in a position to take advantage of [home automation]" by developing and manufacturing around the different protocols. He adds that Molex expects revenue from its home and building automation products to top $300 million over a 10-year span.

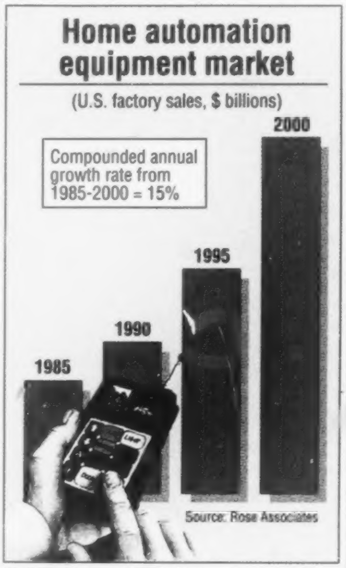
Amp has developed cables, connectors, switches, and "smart outlets" for Smart House that provide flexibility for changes, additions, and extensions to the wiring systems. Amp sources expect Smart House electrical/electronic systems to grow at a compounded average annual growth rate of 45% over the decade.

Another high-growth area, projects Rose's Schliebus, is controllers—central units (consisting of the brain, a relay, and interface equipment such as bridges or gateways) that communicate with household products. Although the market for HA controllers in 1990 was only $600 million, the figure is expected to increase to $2.3 billion by 2000. The overall compounded average annual growth rate is expected to top 15%, says Schliebus, although whole-house controllers could grow at a rate of 36%.

INTERFACE EQUIPMENT also includes user interfaces such as telephones, remote controls, TVs and VCRs, touch pads, and voice-recognition systems. Interface equipment was worth $83 million in 1985 but could reach nearly $1 billion by 2000, growing at an average of 17% per year.

Even electronics distributors stand to gain from HA. Rose Associates reports that some distributors have already started to set procedures and stock products for servicing the new HA systems integrators and installers. Distributors can expect 5% to 10% of their business to come from HA in the next 10 years, says Schliebus. Molex's Pierce expects that distributors will be called upon to kit various components of its Smart House systems.

The incompatibility of the four protocols will also open up niche markets for developers of gates, ports, routers, and buses in order to allow interoperability among appliances originally geared toward a specific protocol.


Home automation equipment market

(U.S. factory sales, $ billions)

Source: Rose Associates

Still, problems exist for each protocol and for the overall HA market, not the least of which is price. Echelon, for example, will not target HA until it can bring its Neuron chip down to the $2 range; in volume, the chip now costs $10 and development tools $14,000. Furthermore, a home designed for the Smart House protocol will cost $7,000 to $10,000 more than a conventional home, and the technology is now pegged only to new homes. Retrofit capabilities are being developed by Smart House, according to Smart House L.P. president Chuck Gutenson.

CEBus has been in development for eight years and has experienced numerous delays in releasing its specs. Other problems cited with CEBus include possible interference with AM radio bands, potential security compromises by hackers, and location of devices so that a CEBus remote doesn't control the neighbor's TV. Critics also point out that CEBus is not a system, so no single organization will develop and market products.

But CEBus developers say that's its advantage: It is a protocol that will allow the user to implement CEBus according to any combination of household media. Homeowners can hook up products one at a time, according to their pocketbooks. France's Thomson Consumer Electronics, for example, is displaying an RCA TV receiver in a CEBus "Bright Home" sponsored by Indiana Power and Light and PSI Energy. Several companies—including Panasonic, Diablo Research, Mitsubishi, Scientific Atlanta, Sony, and Tandy—have been working with the CEBus Committee to finalize the protocol.

X-10, while offering a low-cost solution to HA (its Protector Plus starts at around $115), is limited by its one-way communication path—it turns a device on, but the user doesn't get feedback to tell if the device *is* on. Nor can products communicate with one another. According to Scheffler, however, those advances are in development. But since X-10 is an engineering and design company, there is no reason why the company could not develop for a competing standard.

ANOTHER POTENTIAL obstacle for HA is the possibility that manufacturers will hold off on product development until a single standard emerges. But X-10's Scheffler predicts that, as with computers, standards will develop once the products arrive on the market, not the other way around. "You've got IBM, Sun, Compaq, Apple, and so on," he explains. "So far, everybody is surviving. Will it all come together into one system? I don't think so. The consumer will make choices based on what his pocketbook will bear."

Indeed, most manufacturers seem unconcerned about the multiplicity of protocols, as long as they are allowed to develop for or be licensed by any or all of them. Says Smart House's Gutenson, "We all need to get into the market first. Until that happens, it doesn't make sense to pursue compatibility." ☐

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Electronic Business®

FOR THE MANAGEMENT TEAM IN ELECTRONICS, COMPUTER, AND SYSTEMS COMPANIES—WORLDWIDE SEPTEMBER 9, 1991

CAN BIG BLUE CHANGE ITS STRIPES?

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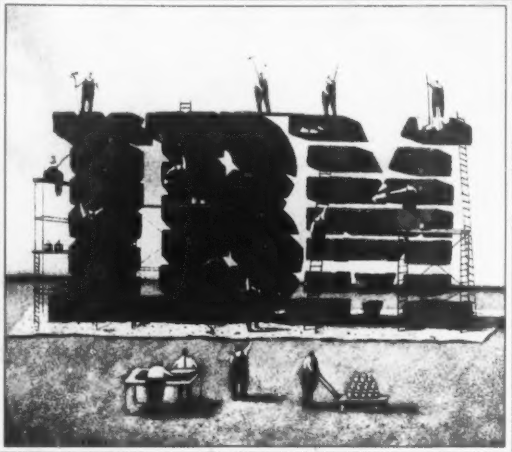

Cover illustration by David Cutler

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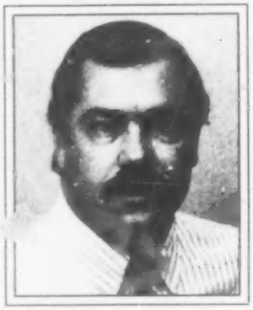
INSIDE BUSINESS

An action plan for IBM



West Coast managing editor Hugh Willett

WHAT WOULD you do differently if you ran IBM? That question might have seemed like an utterly idle exercise in the past. After all, IBM has been doing what it does well for so long and on such a massive scale that it would have been tough to find a way any one of us could have added to their winning formula.

That's the past. Today Big Blue is making headlines with a steady stream of bad news: a 92% drop in quarterly income, a work force reduction in the tens of thousands, and a dwindling share of the world computer market. IBM's problems affect customers, suppliers, and investors alike, so it makes sense to scour the industry for the best advice available for a company in trouble.

In researching the IBM cover story, senior editor Rick Whiting and new West Coast managing editor Hugh Willett found agreement among analysts and executives in several key areas. "Rather than ask what was wrong with IBM, we asked what experts would do if they ran IBM," says Hugh, who brings a wealth of Silicon Valley experience as the former technology editor and West Coast bureau chief for *Electronic Buyers' News* to the West Coast editorial operation at ELECTRONIC BUSINESS.

IBM, the experts say, needs to focus more on desktop PCs and workstations and de-emphasize the mainframe and minicomputers that it once relied on. In fact, IBM needs to shift its concentration away from computer hardware and focus on software and services.

There is praise for IBM's recent cost-cutting and its strategic alliances with Apple Computer, Lotus Development, and Wang Laboratories as "steps in the right direction," but the experts agree that Big Blue needs to run, not plod.

One important change has been IBM's foray into the OEM channel, reports associate editor Dave Webb. Making components available on the open market will be part of the needed breakaway from dependence on direct sales and support.

"We do know one thing: It will be difficult for IBM to change from a self-sufficient to a nurturing corporate culture," says Hugh. "Joint ventures aren't new to IBM, but until now those relationships have consisted of small companies toeing the party line. The new thinking amounts to a change from dictatorship to democracy."

—By John Parker

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FOREIGN INVESTMENT

Who's afraid of the big, bad Japanese buyer?

WHEN IT COMES to buying into the U.S. electronics industry, Japan appears to be getting more for its yen than ever. While some observers see that as a signal for Congressional intervention, others cast the trend in a much more positive light for the U.S. economy.

Japanese equity investments in the U.S. computer, peripherals, semiconductor, and software industries fell from $2 billion in 1989 to $980 million last year, according to a recent study by Ulmer Brothers Inc., a New York-based investment banking firm. But the number of Japanese mergers and acquisition-related transactions climbed to 49 last year, compared with 41 in 1989 and just 16 in 1988.

The nature of the investments suggest Japan is trying to cut its dependence on sunset industries such as steel and agricultural machinery, according to Daniel M. Schwartz, managing director of Ulmer Brothers. "Regardless of how leading the acquired technology is, the underlying strategy seems directed at maintaining Japan's strong industrial base," says Schwartz. The most active Japanese buyers since 1987 have included Kubota Corp., a farm machinery manufacturer, as well as Kobe Steel Ltd. and Sumitomo Metal Industries, both mining and metals concerns.

This past May, Clyde Prestowitz's Economic Strategy Institute unleashed its own study of Japanese acquisitions of U.S. high-tech companies, timed in conjunction with the introduction of a bill in Congress to tighten the U.S. government's review process for foreign acquisitions. Prestowitz believes that Japan's investments in small, cash-strapped companies is weakening the United States' technology lead.

But others take a more sanguine view, in some cases arguing that foreign direct investment has the same potential for boosting efficiency and growth in the 1990s as trade had in the '50s and '60s. DeAnne Julius, chief economist for Shell International Petroleum Co., notes that foreign direct investment is at least one-tenth the size of world trade. But foreign direct investment, says Julius, is only the initial way in which companies establish themselves in target markets and create flows of goods and services that are "analogous to exports and imports" for years after the initial investment. However, while imports and exports are given much attention during bilateral trade negotiations, global foreign direct investment policy has been largely ignored.

As the protectionists and free traders battle it out, accurate readings of the statistics will be even more critical. The Bureau of Economic Analysis says investment outlays for computer and office equipment companies by all foreigners, including Japan, dropped 65% to $567 million in 1990 from $1.6 billion in 1989. Foreign investment in the U.S. components industry fell 3% to $1.2 billion in 1990 and instruments contracted 5% to $1.5 billion.

—By Elizabeth B. Baatz and Linda Stallmann

Japan's $5 billion stake in U.S. electronics

1987 through first quarter 1991

Industry	Number of deals	Value ($ millions)
Semiconductors	59	$2,828.9
Computers	18	1,063.6
Distribution/Sales	10	633.3
Peripherals	31	424.0
Software	23	70.1
Total	141	5,019.9

Source: Ulmer Brothers Inc.

COMMUNICATIONS

User group to address corporate networking needs

ARE CORPORATE users ready to take responsibility for driving the future of computer networking?

A newly formed users group thinks so, and some of the most influential network equipment and software vendors in the industry agree with them.

Still in the start-up stage, Open User Recommended Systems (OURS) was nurtured into existence by local networking software leader Novell Inc. of Provo, Utah. "Large multivendor system environments are coming to the point where the users, not the vendors, need to define what developments need to be done next," says a Novell spokesperson. Novell executives also note the growing complexity of servicing and supporting networks that contain products from many vendors and believe OURS can help formulate methods to ensure adequate multivendor support.

How OURS will achieve these and other goals—such as compatibility testing and rating of network products—remains an open question. The group's steering committee will meet for the first time this fall to hammer out operational and organizational details. "There are numerous possibilities. We still need to figure out what we should do," says committee member Elaine R. Bond, senior vice president of corporate systems at Chase Manhattan Bank in New York.

Other than Novell, which has committed to underwriting the expense of the first steering group meeting, those vendors that support the OURS concept so far have had to contribute little more than their names to the effort. The group's still-undefined agenda and participating vendor requirements have caused at least one major player to hold off in lending its name. Microsoft, of Redmond, Wash., is reportedly waiting to see if OURS will succeed in addressing the needs of large networking users.

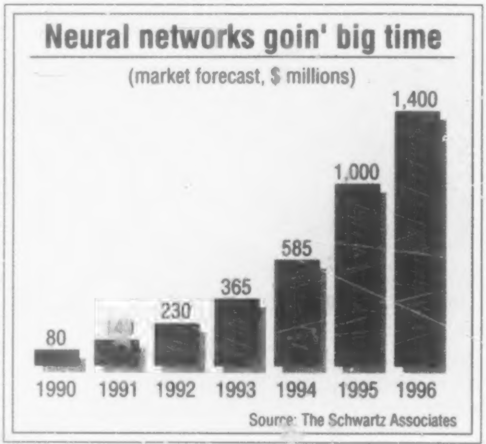
—Dwight Davis in Seattle

ADVANCED COMPUTING

Neural networks are still searching for a market

COMDEX IT WASN'T. When the International Joint Conference on Neural Networks invaded Seattle in July, the city's residents could be forgiven for not noticing. Still, the message of the conference was clear: Neural networks are ready for the big time.

But is the market ready for neural networks? Beyond the rarefied world of research institutions, this specialized branch of parallel computation still generates more head-scratching than brainstorming. Neural networks employ multiple layers of real or simulated processing nodes to first "learn" desired patterns and later to recognize and classify similar patterns. That makes neural networking systems natural candidates for handling such tasks as image analysis and speech recognition.


Neural networks goin' big time

(market forecast, $ millions)

Source: The Schwartz Associates

A handful of companies offer software tools for developing neural network applications; an even smaller group sells chips, boards, or systems based on neural network architectures. The most successful of these so far are niche vendors such as HNC Inc. of San Diego and NeuralWare Inc. of Pittsburgh, which both offer application development tools. HNC also offers the Balboa 860, a hardware coprocessor board for PC/AT and VME-bus computers.

But some better-known companies are also active in the field. At the conference, IBM's Applications Business Systems division exhibited its AS/400 Neural Network Utility for developing and deploying business applications. Intel demonstrated its Electrically Trainable Analog Neural Network chip and discussed a future chip being co-developed with Providence-based Nestor. Corporations presenting reports on in-house neural network projects included Boeing Computer Services and Kodak.

All told, the entire neural network industry generated revenue of about $80 million last year, according to Tom J. Schwartz, president of consulting firm The Schwartz Associates. Sixty percent came from consulting and development contracts, 25% from hardware sales, 10% from software, and 5% from education and other activities. By 1996 the neural networking market will achieve revenue of $1.4 billion, and consulting and development will drop to 5% to 10% of the total.

The near-term market will remain that of application developers and researchers, admits John Heightley, president and CEO of Adaptive Solutions of Beaverton, Ore. The company plans to ship its $55,000 Connected Network of Adaptive Processors system by late this year. Once applications are developed, Heightley expects the big boom in neural network proliferation to occur as the technology merges with more familiar computer architectures and as it migrates to embedded applications in automobiles and other consumer products.

—Dwight B. Davis

CONSUMER ELECTRONICS

LSI and Sanyo team up to reduce HDTV costs

AS DEVELOPERS fret about the high selling cost of HDTV and suppliers look for ways to jump-start the market, Milpitas, Calif.-based LSI Logic Corp. has teamed up with Sanyo Electric to develop a compact decoder chipset. The chips will be manufactured at Nihon Semiconductor Inc., a joint venture between LSI Logic and Kawasaki Steel.

The smaller chipset will mean lower prices for HDTV sets because of lower component and assembly costs. System costs also will be cut because the printed circuit board area will be about one-fourth the size.

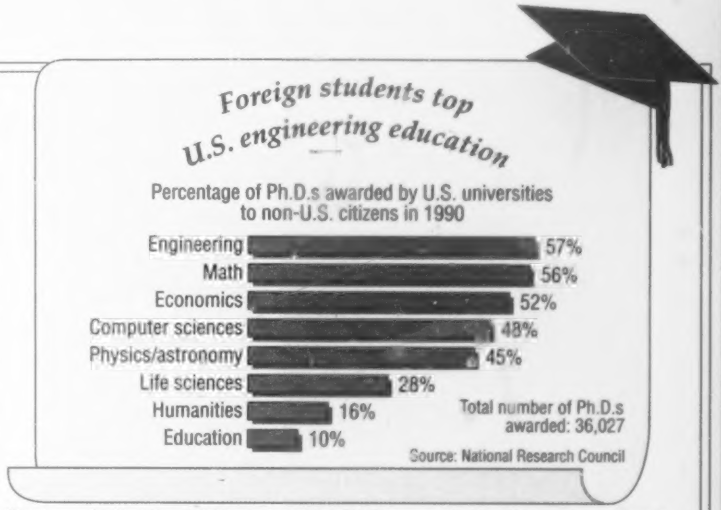
The LSI-Sanyo venture underscores the view expressed during the recent chip talks between Japan and the United States—that U.S. chip companies might find a strong market in consumer electronics as more of these products become digital.

Both companies will have the right to sell the chipset, but the ICs will work only in HDTV systems designed for Japan's market. While the chipset gets LSI Logic deeper into Japan's consumer-electronics market, it will not be a bonanza. Less than 1 million chipsets will be sold over the next five years, and only 10 million by the year 2000, estimates Itsuro Nishimura of Sanyo's Audio-Video business.

The decoder is a key element in the HDTV system developed by NHK, Japan's government broadcasting company. The picture is broadcast in a complex analog format then digitally decoded in individual receivers. Today, a decoder set is made up of 46 special-purpose ICs plus memory chips. LSI intends to reduce the number to between 6 and 10 chips.

The deal could have other implications. K. K. Yawata, president of LSI Logic in Japan, thinks the chipset will help spur his company's transition from a maker of application-specific ICs to a supplier of application-specific standard products that can be sold to more than one customer.

—Charles Cohen in Tokyo



Source: National Research Council

Well over half of the 4,892 engineering Ph.D.s awarded by U.S. universities in 1990 were earned by foreigners; 2,191 of the new engineering doctors had temporary visas and 376 had permanent visas. Foreign nationals accounted for a large percentage of doctorates in math, economics, computer sciences and physics/astronomy as well. Overall, 30% of all doctorates were awarded to non-U.S. citizens last year

—Elizabeth B. Baatz

STRATEGIES

Intel: Under siege or plotting a new attack?

WITH THE PC market in the doldrums and workstation makers migrating toward a half-dozen or more new high-performance microprocessor sources (such as those based on SPARC and Mips RISC architectures), some observers wonder if Intel has had its day in the sun.

Some of the evidence suggests so. Intel CEO Andrew Grove recently told financial analysts that June bookings were disquieting enough to affect sales in the current quarter. Sales of the 80386 family to first-tier customers flattened, and sales to second-tier customers actually dropped. Grove noted that 80486 family sales were on a ramp, but with the system CPU pie split so many ways lately, the best scenario of 486 sales will probably be only a pale reflection of Intel's success in the '80s with its 386 microprocessors.

There is also a contrary view. Dan Hutcheson, president of San Jose-based analyst firm VLSI Research Inc., claims to see a long-term strategy evolving at Intel that has less to do with microprocessors and more to do with exotic growth markets, such as multimedia. He points to Intel's manipulation of the memory chip market at the end of the 1970s, when it misled Japanese competitors for about four years while preparing to exit the DRAM market.

Hutcheson says Intel is investing the billion dollars a year it intends to spend on R&D not just on the 80x86 family, but also on multimedia and signal-processing capabilities. The forces lining up to "get Intel" may again find themselves holding the bag as the growth in the electronics markets shifts to new products, he says.

With the acquisition of RCA's digital video interactive (DVI) research lab two years ago, the introduction of its i750 DVI processor, and creation of the multimedia and supercomputing components group last spring, Intel is obviously gearing up to take the lead as multimedia becomes one of the biggest growth opportunities of the '90s.

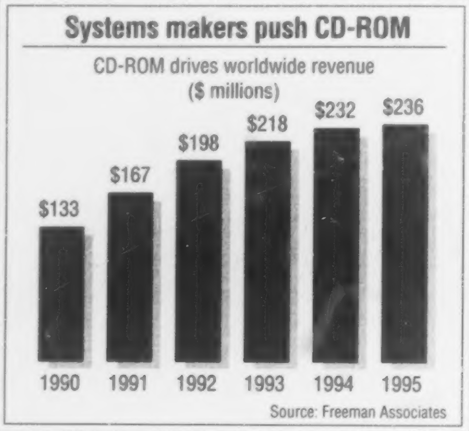
Meanwhile, the latest financial results still look good: For the second quarter ended June 29, Intel reported revenue of $1.25 billion, up 29% from $968 million a year ago. Net income was up 35% to $231 million, compared with $171 million. Intel has been profitable for the last four quarters.

—Teri Sprackland in San Jose

COMPUTER PERIPHERALS

CD-ROM is gaining among top tier computer makers

AT A BREAKOUT session held during a Sun Microsystems Inc. system compatibility conference in July, a Sun product marketing manager outlined Sun's strategy to embrace compact disc/read-only-memory (CD-ROM) peripherals. William Petro, the product manager, said



Systems makers push CD-ROM

CD-ROM drives worldwide revenue
($ millions)

Source: Freeman Associates

Sun was not only validating its year-and-a-half-old strategy to incorporate CD-ROM as a software distribution medium, but also validating CD-ROM as a medium.

That isn't too brash a statement, although realistically speaking Sun hasn't single-handedly given CD-ROM the credibility drive manufacturers and CD publishers have long sought. But combined with the CD integration efforts of IBM, Digital Equipment, Hewlett-Packard, and Apple (to name just a few), CD-ROM has finally found celebrity status in the computing world. Three years ago it was tough to find a CD-ROM drive; now they can be found not just integrated into brand-name systems but also on the shelves of electronics superstores and major distributors.

All of the above companies, save Apple, offer CD-ROM options with workstations and file servers, and all seek to eventually shift operating system and application software distribution to compact discs from conventional tape. Apple, of course, is using CD-ROM to not only proliferate its own means of software distribution, but as a critical component of its multimedia market strategy.

Sun appears to be furthest along in the race to add applications available on compact disc and broaden its installed base, but DEC has been working for years to deliver VMS applications to its VAX community. HP is well along, though it has to balance its software distribution medium of choice between data digital audio tape drives and CD-ROM.

According to Freeman Associates, a storage research firm, worldwide revenue for CD-ROM drives will grow from $133 million in 1990 to nearly $167 million this year and $236 million in 1995. Freeman estimates that 596,000 drives are likely to be shipped worldwide this year. In 1995, says the firm, more than 1.2 million will be shipped.

Not surprising, there isn't a single U.S. vendor that makes CD-ROM drives. The Japanese—led by Hitachi, Sony, and Toshiba—lead the pack in worldwide market share, followed by Europe's N.V. Philips. On the bright side, U.S. companies hold a strong share of the publishing market, including the market for hardware used to publish compact read-only discs.

—Dave Webb in San Jose

CONSUMER ELECTRONICS

Consumers wait, watch digital recording wars

THOSE UNFORTUNATE consumers with a Sony Betamax video tape recorder packed away in the closet will be paying close attention to the battle between competing formats of digital audio tape and recordable compact discs before making their next audio purchase.

In July, the recording industry reached an agreement with major electronics manufacturers that will clear the way for fully digital recording by consumers. The technology allows home audiophiles to make digital recordings that are virtually indistinguishable from those made and sold by the music industry. Not surprisingly, that has long been opposed by recording companies because it would cut into their profits on compact discs and other prerecorded music formats.

Under the new pact, a royalty payment based on 2% of the equipment's price (about $8 per unit) and 3% of the recording media's price (about 25 cents per cassette) would be paid to the record manufacturers on all machines, tapes, and compact discs sold.

What consumers and audio equipment makers haven't figured out yet is which of the several competing digital formats will dominate. At present, three formats are vying for recognition as the digital recording medium of choice:

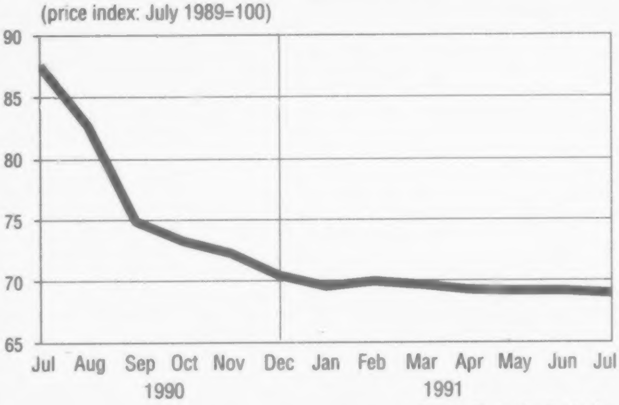
- Standard digital audio cassette players of the type that have been available for several years in Japan. They can play digital tapes but not conventional analog tapes;
- New compact digital cassette players, to be introduced next year by Philips, which are interchangeable with standard audio cassettes and thus allow consumers to use their old tapes. The technology has been endorsed by Japanese audio giant Matsushita Electric and Tandy;
- The Mini Disc, a small compact disc scheduled to be introduced by Sony next year, that can be used to record as well as to play. The Mini Disc players are not compatible with current large-format compact discs.

The upcoming battle of the digital recording formats recalls the days when video recording was a young technology split between the VHS and Sony's Betamax standards. VHS technology was widely licensed and eventually displaced Beta, leaving Beta owners with a dearth of video material for their machines.

The jury is still out on which digital audio recording format will find favor with users, though the match of Japan's audio giant Matsushita with Europe's N.V. Philips seems to give the compact cassettes a slight edge over Sony's Mini Discs for the moment. The market will be watching to see who lines up with Sony this time.

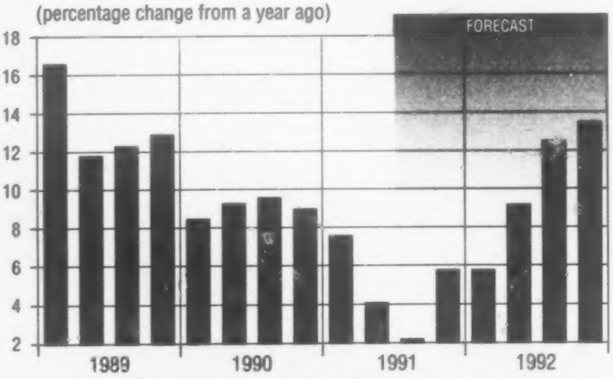
—Hugh G. Willett in San Jose

Semiconductor prices hit the skids



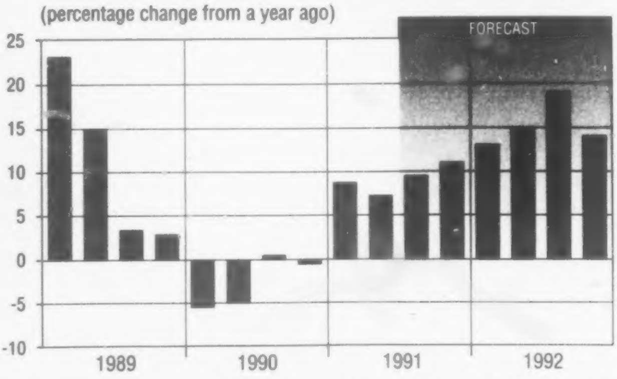
Source: *Electronics Purchasing*

But rising electronics production...



Source: Federal Reserve Board; forecast: Cahners Economics

...should boost chip sales



Source: Semiconductor Industry Assn.; forecast: Cahners Economics

Chip sales revival continues on a roll

AFTER A disappointing 1990, semiconductor sales so far in 1991 are looking better and better. According to the Semiconductor Industry Association, semiconductor sales to the North American market in the second quarter of 1991 advanced 7.3% from year-ago levels. Although this quarterly gain pales in comparison to the double-digit growth enjoyed in past years, it marks the first two-quarter consecutive increase in sales since 1989.

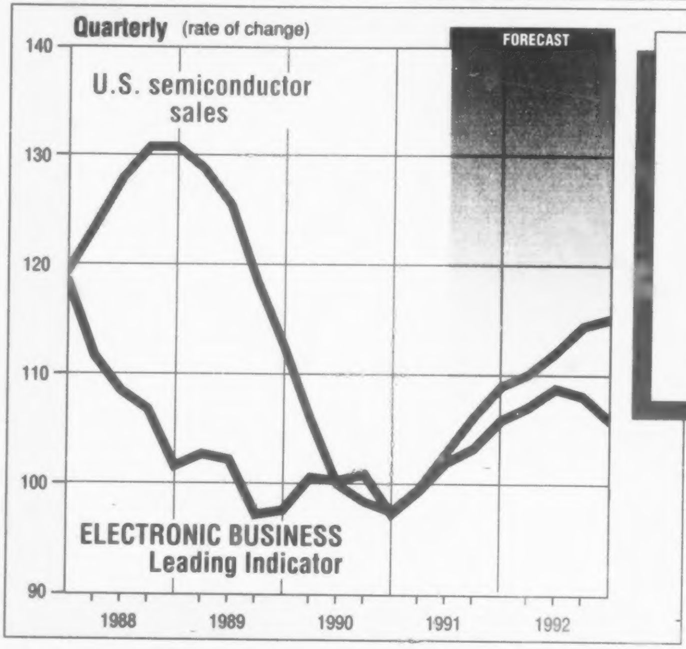
As for the future, the chip forecast looks even better. With only $10.8 billion of inventory, the lowest level in three years, computer makers should be replenishing their inventories soon. Computer production at U.S. factories will grow 10.3% next year. Although this is still slow growth by historical standards, each computer will be using more chips than ever, so semiconductor sales should fare better.

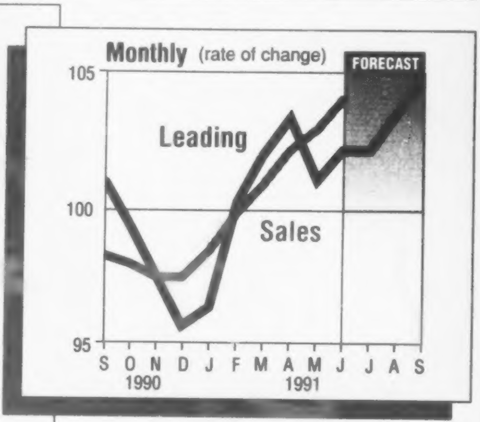
In addition to renewed end-market demand, prices for semiconductor chips also influence the forecast for semiconductors. Based on *Electronics Purchasing* magazine's survey of buyers, semiconductor prices have leveled off recently. The semiconductor price index stood at 69.0 in July, virtually the same as the prior month, and marked the eighth consecutive month that the index registered around the 70 mark. Higher chip prices, however, are expected later this year and next, translating into stronger dollar-valued semiconductor sales.

Cahners Economics expects U.S. chip sales to continue rising throughout the rest of 1991, up 9.1% by the end of the year. Next year will prove to be an even stronger year than previously expected. Look for sales to climb 15.3% to $18.2 billion in 1992.

—By Julie Handelman

ELECTRONIC BUSINESS Leading Indicator

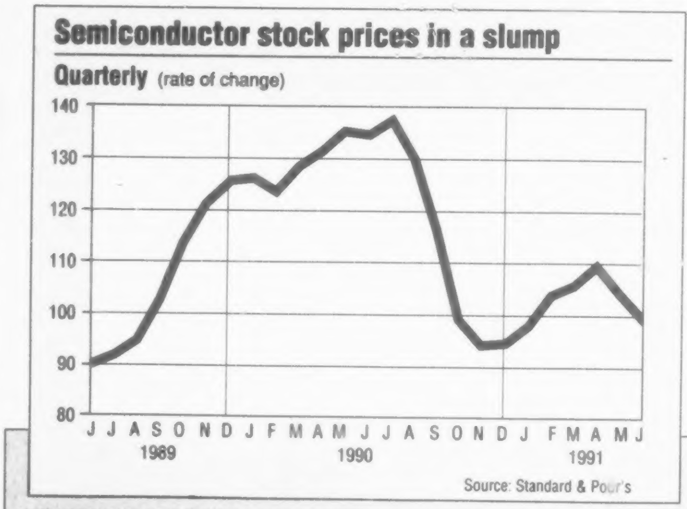




Leading indicator takes a step forward in June

IF THE RECOVERY ends up as one step back for every two steps forward, remember the ELECTRONIC BUSINESS Leading Indicator said so first. The EBLI rose in June to 102.1 after dipping in May; orders for semiconductors declined during the latest two months; and investors, fearing slow earnings growth, are paying less for chip stocks. The EBLI's upward path will be bumpy until a new peak is hit next June.

EBLI is a weighted composite of six statistics that lead activity in the electronics industry. To obtain your complimentary background paper, contact Cahners Economics at (617) 630-2119; fax (617) 630-2100


Semiconductor stock prices in a slump

Source: Standard & Poor's

	Latest month	Previous month	Year ago	1990 average
ELECTRONIC BUSINESS Leading Indicator (rate of change, June)	102.1	101.0	100.1	99.9
U.S. semiconductor bookings ($ millions, 3-month average, June)	$1,321	$1,348	$1,290	$1,254
Weekly hours of semiconductor production workers (monthly average, May)	40.9	40.8	40.6	40.4
Electronic components lead time index (1977 = 100, July)	73.7	94.2	82.7	80.7
S&P's semiconductor stock price index (1970 =10, monthly average, June)	72.2	73.2	79.7	64.6
Change in electronic components inventories ($ millions, SA, May)	-$31	$91	$65	$33
Contracts and orders for plant and equipment ($ billions, SA, May)	$34.0	$33.0	$37.7	$38.3

SA = seasonally adjusted; all other data are not seasonally adjusted

Sources: Semiconductor Industry Association, Bureau of Labor Statistics, *Electronics Purchasing*, Standard & Poor's, Commerce Dept. , Bureau of Economic Analysis

Do or die for Hong Kong chip makers

Low-end competition and lack of capital may force semiconductor companies into new strategies

By Drew Wilson

Facing stiff competition from Taiwan and Korea in the low-end chip market, Hong Kong's three semiconductor manufacturers—Vitelic (HK) Ltd., RCL Semiconductors Ltd., and Hua Ko Electronics Inc.—seem to be cornered. They can't stay in the low-end market, but neither are they able to compete at the high end.

At least two companies, moreover, can't afford to replace aging equipment, and it is virtually impossible for them to catch up with government-assisted regional competitors that are "$10 billion and 10 years ahead," according to Charles Chapman, executive director of the Hong Kong Electronics Association (HKEA).

"With ICs you have to keep investing in new equipment and technology if you want high-end work," explains Francis Ko, assistant general manager for RCL. "In the consumer end, capacity is increasing for chips, so we would need between [U.S.] $800,000 to $1 million in new equipment to overcome the bottleneck." Without significant government investment, he adds, "there is no chance of competing with Taiwan and Korea."

Vitelic's managing director Raymond Wang agrees, noting that 80% of the production equipment his company acquired last year in its purchase of Hong Kong's Elcap Electronics Ltd. is dated. He argues that the semiconductor industries in the United States, Japan, and Korea were not started by the private sector but through government investment. "It's a capital-intensive, talent-intensive business, and the Hong Kong government is not aggressively promoting such a thing," he says.

The three small companies that make up Hong Kong's semiconductor industry—housed in modest buildings within shouting distance of each other at Hong Kong's Tai Pao Industrial Estate—are a far cry from the advanced and prolific semiconductor makers of Japan, Korea, and Taiwan. For the most part, they quietly turn out unsophisticated complementary metal-oxide semiconductor (CMOS) chips for low-end products such as watches, clocks, musical greeting cards, and calculators. Vitelic's Wang estimates that the three companies together do about $50 million in business "in a good year."

Without government aid, "there is no chance of competing with Taiwan and Korea" in chips, says RCL's Francis Ko

Vitelic's main product in Hong Kong is CMOS consumer-product chips with circuit widths of 2 to 5 microns. It produces 8,000 to 10,000 4-inch wafers monthly, each containing 1,500 to 2,500 chips, on its class-100 production line. It also makes 256-kilobit dynamic random-access memory (DRAM) chips with circuit widths of 0.8 to 1 micron, using a separate class-10 production line.

AS HONG KONG's only DRAM producer, Vitelic makes about 2,000 4-inch DRAM wafers monthly, each containing 200 to 300 chips for products such as PC monitors and "talking" toys. While its DRAM volume is low, Wang says a market for these chips will always exist. The company's chips are packaged at a joint-venture plant across the China border in Shenzhen. Wang says Vitelic's long-term strategy is to use its Hong Kong operation as a verification center for its class-10 line before putting new designs into high-volume production at plants elsewhere.

Although it has no current plans to stop making its consumer chips or 256K DRAMs, Wang says the company wants to put more effort into high-end products such as static random-access memories (SRAMs) and voice and communications circuits. It also plans to develop a 1-megabit DRAM chip by the fourth quarter, and soon after that a 4-Mbit chip. "We could add a 16-Mbit afterward," says Wang. "It only means we'll have the capability [in Hong Kong]. We'll be doing small runs to verify that the process works."

Vitelic would like to expand production in Hong Kong by year-end to three daily work shifts and a seven-day work week, which would increase wafer production by 30%. The company also hopes to invest $10 million to switch from 4-inch to 5-inch wafers, which could double the present output. "With the 5-inch wafers, we hope to reach $40 million to $50 million per year," Wang says.

BUT ALL THOSE PLANS, and the company's future, depend on obtaining additional financing. The cost of building a still-unfinished second fab in Taiwan, as well as the Elcap acquisition, forced Vitelic to negotiate a merger with Taiwan's Hualon Microelectronics Corp. A letter of intent was signed in April, but at press time the deal still seemed far from certain, partly due to Hualon's difficulties in a securities scandal in Taiwan.

Vitelic's Hong Kong operation does business mainly with local companies. Wang would like to sell low-end chips to China, but he's not counting on it. "China has its own wafer fab industry," he says. "If they get organized, we could all be out of business." Others in the industry disagree, citing China's outdated equipment, inadequate management, and reports that wafer yields at fabs in China are typically 20%—less than one-third of what's considered acceptable elsewhere.

While Vitelic aims to become a test and verification center, RCL Semiconductors is planning for diversification. "We're trying to move out of the low end," says assistant general manager Ko. "You can't survive by chip making in Hong Kong—we want to sell a complete product."

RCL's monthly production of 4-inch and 5-inch wafer lines is reportedly close to Vitelic's monthly 4-inch wafer output. The company contracts its bipolar process work to a mainland factory in Wuxi and also uses subcontractors for packaging.

RCL used to limit itself to low-end chip production for local manufacturers, but Ko says it now needs a more global approach. RCL wants to begin making a complete electronic product—"something between a toy and a personal computer"—that could be sold in the United States, where the company is setting up a marketing office.

Hong Kong's chip companies might do well to concentrate on developing innovative niche products

Although RCL often uses customer-supplied design, it also has a 20-person design staff. But because it is difficult to recruit and keep experienced designers in Hong Kong, RCL has established a design house in Shenzhen and plans to hire top engineers from mainland universities. Chinese engineers are highly skilled and they tend to stay with one company, Ko says, adding that RCL will also have a North American design office by 1992.

Hong Kong's three semiconductor makers

Vitelic	
Employees:	300
1990 revenue:	$15 million
Products:	CMOS chips, 256K DRAMS, SRAMs for consumer products
RCL Semiconductors	
Employees:	300
1990 revenue:	$10 million
Products:	CMOS chips for consumer products and LSD displays
Hua Ko Electronics	
Employees:	250
1990 revenue:	$10 million
Products:	CMOS chips for consumer products

Source: *Electronic Business Asia*

Hua Ko Electronics, with 250 employees—the smallest of the colony's chip makers—plans to stay on the low-end track, making chips for watches, toys, and clocks, where Mixin Wang, the company's systems manager, insists business is good. The company reported $10 million in revenue last year.

Bill Kahl, vice president of Asia marketing for National Semiconductor Corp., says opportunities continue at the market's low end. "Transistors, which are the earliest form of semiconductors, are still used today."

Kahl says Hong Kong's chip companies might do well to concentrate on developing innovative niche products. "Semiconductors and applications are so pervasive that the big companies can't be all things to all people," Kahl says. "The big guys focus on areas with maximum return while the small guys fill small areas. With a niche, it's not too difficult to grow to $50 million to $100 million."

The HKEA's Chapman adds that the three companies could take advantage of their small sizes to do shorter, more customized chip runs. "The Japanese are too big to do that," he says. "You don't go to Toshiba and ask for 20,000 chips."

Chapman adds that the territory is dependent upon imported semiconductors and that a stronger local chip industry would help to regulate chip price fluctuations. Local producers can stabilize the market, he explains, by stepping production up or down according to demand.

But National's Kahl thinks the lack of an indigenous semiconductor industry isn't necessarily a liability. "Some countries believe they have to stay ahead in semiconductors to compete in electronics," he says. "That's not true. There's a worldwide overcapacity. A lot of companies are competing and that drives the margins down. You don't have to be at the leading edge to compete." ☐

Contract manufacturing grows despite the recession

Or maybe because of it, as electronics and computer makers realize it's cheaper to buy than to make

By Alberto Socolovsky

When Texas Instruments' 99/4 personal computer died in 1984, it caused the shutdown of an assembly line at the company's Johnson City, Ala., plant. Since idle equipment doesn't help the bottom line, TI's plant managers looked for some outside assembly work. But by 1989 TI's contract manufacturing operation had reached only $50 million in sales, and as recently as last year, it rated only a small paragraph in the company's annual report.

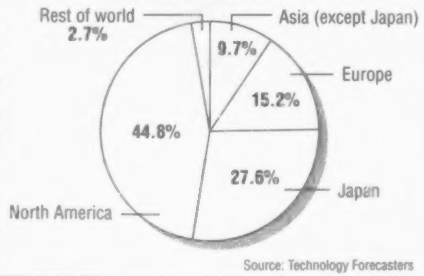
Now called Custom Manufacturing Services and boasting revenue estimated at $150 million (mostly from surface-mount technology), it has moved higher in the company's organization chart and wider in geography and markets. With five plants in the United States and one in Italy, CMS performs complete manufacturing work for customers ranging from Ford Motor Co. to consumer, communications, industrial, medical, and electronics companies.

The forces fueling TI's growth in contract manufacturing—surface-mount technology and the expansion of TI's customer base beyond computer companies—are also responsible for the growth of this market even in the face of tough times for U.S. electronics and computer companies. A recent study by the Institute for Interconnecting and Packaging Electronic Circuits (IPC) of Lincolnwood, Ill., says the U.S. market for contract manufacturing grew by 20% in 1990 and will keep growing by at least 15% annually through the 1990s. Market researcher Technology Forecasters in Berkeley, Calif., says U.S. customers gave out $6.5 billion in electronic manufacturing contracts in 1990.

The United States accounts for nearly half of the world market, estimates A. Eugene Sapp Jr., president and CEO at SCI Systems Inc. in Huntsville, Ala., the leading contract manufacturing company with $1 billion in sales last year. Sapp cautions that, as long as the economy is in recession, "we have to go slow" in adding customers. He speaks from experience. In 1989, SCI wrote off more than $10 million in unpaid assembly work for Priam Corp., a bankrupt manufacturer of high-performance disk drives.

Demand for contract manufacturing of electronic equipment

Total 1990 market: $14.5 billion



Source: Technology Forecasters

Fast-growing contract manufacturer Comptronix Corp., based in Guntersville, Ala., shuns disk-drive customers now as well. According to president Allen L. Shifflett, Comptronix's largest customer in 1988 was Miniscribe, which failed and was acquired by Maxtor Corp. Later Conner Peripherals, Comptronix's largest customer in 1989, succeeded to the point that it needed a higher-volume capacity than Comptronix could provide and switched suppliers. Conner is now a customer of third-largest contract manufacturer Solectron Corp. in San Jose.

But despite the volatile marketplace, disk drives (as well as PCs) remain the largest customers for the top three U.S.-based contractors—SCI, Avex Electronics Inc. in Huntsville, Ala., and Solectron.

IPC analyst Anthony Hilvers shows how much room there is for contract manufacturers to grow. Because the Institute has

The top five

Contract manufacturers, ranked by their 1990 sales ($ millions)

SCI Systems	$ 1,000
Avex Electronics	265
Solectron	205
Jabil Circuit	180*
Philips N.A. Circuit Assembly	160*

*Estimated

Source: Technology Forecasters

a good handle on total value of printed wiring boards used in the United States—and since PWBs are the most expensive and ubiquitous components in electronic equipment, used by OEMs and contract manufacturers alike—Hilvers estimates that these manufacturers do approximately 12% of the total electronics assembly in the United States. On that basis, the IPC forecasts continued growth for contract manufacturing in the United States through the rest of this decade.

The reason is that contract manufacturers, besides offering up-to-date assembly technology, can do so more economically than their customers can. Last year, OEM productivity measured as sales per employee ranged from $104,000 for unprofitable Digital Equipment Corp. (which uses hardly any contract manufacturing) to more than $300,000 for the very profitable Apple Computer and Compaq Computer, both big customers of contract manufacturers.

Another company reaping the rewards of contract manufacturing is Ampex Corp., which sold the assembly plant in Colorado Springs, Colo., of its Audio Video Systems Division to Comptronix. Comptronix gained capacity and a good customer, while Ampex gained cash and the ability to focus more resources on its main business.

THE FAR EAST holds the most potential "for our greatest near-term growth," says SCI's Sapp. Most companies recognize that their offshore competitors benefit from lower labor rates—significant for high-volume products or those with a high labor content.

"We could grow very fast in Asia," confirms Avex's senior marketing manager John Coan. SCI has recently expanded a plant in Bangkok while closing a plant in Southern California. Another large assembler, $150 million Flextronics International, previously based in California, has restructured as a Singaporean company to operate high-volume assembly plants in Singapore, Hong Kong, and the People's Republic of China, leaving stateside only a small prototyping facility in Massachusetts.

Even with the difference in volumes and labor rates, contract manufacturing in Southeast Asia is a merchant environment, "much like in North America and the U.K.," says market analyst Tim Sturgeon of Technology Forecasters. By contrast, he explains, Japan's vertically integrated industry makes contract manufacturers assemble equipment mostly for their parent or affiliated companies. On the other hand, he says, most European (excluding British) contractors are small; the few large ones are U.S. companies. Among the top 10 contract manufacturers ranked by Sturgeon are two British companies, A.B. Electronics and Race Electronics.

Contract houses such as Solectron embraced the concept of total quality manufacturing early on and have successfully dispelled the notion that price is the only reason for using a contract manufacturer. Lacking products of their own, however, contract manufacturers are at a disadvantage in the competition for the Malcolm Baldrige National Quality Award. Yet Solectron has applied three years in a row, Avex is gearing to apply this year, and practically all of the larger assemblers have quality programs patterned on the Baldrige guidelines—even "six-sigma" programs that aim to drive the number of defects down to practically zero. "Quality is a given [and so are] competitive prices," says Sapp.

Each company claims to have a unique advantage—multinational support at SCI, semiconductor technology at TI—but essentially all offer a close match with the customer's preferences and modus operandi. "Customers ask us to bridge the gap [between their application and] semiconductor technology," says Robert Gilbert, business development manager for TI's CSM. "In contract manufacturing, you are only as good as the last delivery to your customer." ☐

Who buys contract manufacturing

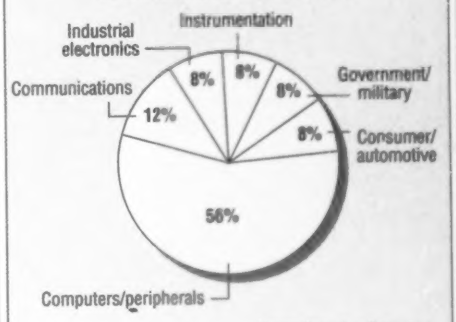
THE INSTITUTE for Interconnecting and Packaging Electronic Circuits (IPC) of Lincolnwood, Ill., conducted a survey last year in which 42 contract assemblers in the United States participated. Their dollar volume, says the IPC, represents 35% to 40% of the U.S. total.

As a whole, computer companies account for half of the business. But these companies favor the larger assemblers. Not surprisingly, consumer/automotive customers accounted for a much smaller market share, because their use of contract assemblers is relatively new.

The major customers of the smaller assemblers are industrial electronics companies, followed by communications equipment concerns. ☐

How the markets break down

for U.S. contract assemblers (1990)



Source: Technology Forecasters

CONTRACT MANUFACTURING

Type of service

- **a** Design
- **b** Product assembly
- **c** Testing
- **d** Turnkey manufacturing
- **e** Cable and harness assembly

Over $50 million

ADI Corp.
14F No. 1, Sec. 4, Nan-King E. Road, Taipei, Taiwan, Republic of China;
Tel.: (02) 713-3337; Fax: (02) 713-6555; Connie Hsu, marketing specialist; a,b,d

AG Communication Systems Corp.
400 N. Wolf Rd., Northlake, IL 60164;
Tel.: (708) 681-7100; Fax: (708) 681-7090; Frank McKay, director manufacturing sales; a,b,c,d,e

Avex Electronics Inc.
4807 Bradford Dr., Huntsville, AL 35805;
Tel.: (205) 722-6301; Fax: (205) 722-6232; Brian Throneberry, marketing director; a,b,c,d

Comptronix Corp.
1800 Gunter Ave., Box 1800, Guntersville, AL 35976; Tel.: (205) 582-1800; Fax: (205) 582-1817; Allen Shifflett, president; b,c,d

Corinth Telecommunications Corp.
Fulton Dr., Corinth, MS 38834; Tel.: (601) 287-3771; Fax: (601) 287-1437; Jim Hopper, VP, plant manager; b,c,d,e

Dover Electronics Manufacturing
(Eastern Division)
Kirkwood Industrial Park, Box 5212, Binghamton, NY 13902; Tel.: (607) 772-7563, Fax: (607) 772-0868; Robert Egan, sales manager; a,b,c,d

Dover Electronics Manufacturing
(Western Division)
1198 Boston Ave., Longmont, CO 80501;
Tel.: (303) 772-5933; Fax: (303) 776-1883; Brent Solman, sales manager; a,b,c,d

Elamex
P.O. Box 10438, El Paso, TX 79995;
Tel.: (915) 592-1991; Fax: (915) 595-0155; Fred Mitchell, VP marketing and sales; b,c,d,e

EMD Associates
4065 Theurer Blvd., Winona, MN 55987;
Tel.: (507) 452-8932; Mark Wolf, sales manager; a,b,c,d

Flextronics International
48001 Fremont Blvd. Fremont, CA 94538;
Tel.: (415) 226-3539; Fax: (415) 226-3535; Sue Mucha, director marketing service; a,b,c,d

GSS/Array Technology Inc.
1297 Parkmoor Ave., San Jose, CA 95126;
Tel.: (408) 297-3333; Fax: (408) 297-3763; Larry McFall, VP sales and marketing; a,b,c,d

IEC Electronics Corp.
105 Norton St., Newark, NY 14513;
Tel.: (315) 331-7742; Fax: (315) 331-3547; Frank Montabana, director marketing and sales; a,b,c,d,e

International Microelectronic Products
2830 North First St., San Jose, CA 95134;
Tel.: (408) 432-9100; Fax: (408) 434-5904; Dhaval Ajmera, marketing manager; d

Jabil Circuit Co. Inc.
10800 Roosevelt Blvd., St. Petersburg, FL 33716; Tel.: (813) 577-9749; Fax: (813) 579-8529; Tim Main, VP business development; a,c,d

NCR Component Evaluation Technology Center
3450 North Rock Rd., Bldg. 100, Wichita, KS 67226; Tel.: 1-800-622-CETC; Fax: (316) 636-4780; Kent Wade, executive account manager; c

Philips Circuit Assemblies
2601 South Moorland Rd., New Berlin, WI 52151; Tel.: (414) 785-6364; Fax: (414) 785-6517; Don Weiland, director marketing/engineering; a,b,c,d

Philips Industrial Electronics
813 S. Grandstaff Drive, Auburn, IN 46706;
Tel.: (219) 925-8774; Fax: (219) 925-8710; Harold Griswold, product manager; b,d

Plexus Corp.
55 Jewelers Park Dr., Box 156, Neenah, WI 54957; Tel.: (414) 722-3451; Fax: (414) 722-3220; Chuck Williams, VP marketing; a,b,c,d,e

SCI Systems Inc.
13000 South Memorial Parkway PO Box 1000, Huntsville, AL 35807; Tel.: (205) 882-4400; Fax: (205) 882-4871; Michael Reale, senior VP Central Div..; a,b,c,d,e

Solectron Corp.
2001 Fortune Dr., San Jose, CA 95131;
Tel.: (408) 942-2971; Fax: (408) 262-3311; William P. Barley, VP business development; a,b,c,d

Sparton Electronics, Manufacturing and Engineering
30167 Powerline Road Brooksville FL 34602; Tel.: (904) 799-6520 or 1-800; Fax: (904) 796-7482; Alan Houghtaling, director marketing; a,b,c,d

Texas Instruments Inc.
P.O. Box 655474, M/S 75265, Dallas, TX 75265; Tel.: 1-800-232-3200, ext. 40; Fax: 214-995-2230; Robert Gilbert, manager business development; a,b,c,d,e

Westinghouse Process Control Div.
200 Beta Dr., Pittsburgh, PA 15238; Tel.: (412) 963-4580; Fax: (412) 963-4063; Jarvis Cotton, marketing manager; a,b,c,d,e

$20 million to $50 million

A.J. Electronics Inc.
20945 Plummer St., Chatsworth, CA 91311;
Tel.: (818) 998-8788; Fax: (818) 407-9440; Ron Viano, marketing and sales manager; b,c,d

ADCO Circuits Inc.
1900 Northfield Dr., Rochester Hills, MI 48309; Tel.: (313) 853-6620; Fax: (313) 853-6698; Archie Damman, VP; a,b,c,d,e

ASD
Industry Street, P.O. 3210, Poughkepsie, NY 12603; Tel.: (914) 473-5530; Fax: (914) 454-2538; Frederick W. Syler, VP sales; a,b,c,d,e

CONTRACT MANUFACTURING

Benchmark Electronics Inc.
802 West Brazospark Dr., Clute, TX; Tel.: (409) 265-0991; Fax: (409) 265-7804; Steve Barton, VP sales; a,b,c,d

EOG Inc.
10947 Golden West Dr., Hunt Valley, MD 21030; Tel.: (301) 785-3000; Fax: (301) 771-5814; Arthur Rutledge Jr., VP marketing and sales; a,b,c,d,e

Hibbing Electronics Corp.
3125 East 14th Ave., Hibbing, MN 55746; Tel.: (218) 263-8971; Fax: (218) 263-8970; Michael Walsh, marketing manager; a,b,c,d,e

Manu-Tronics Inc.
8701-100th St. Kenosha, WI 53142; Tel.: (414) 947-7700; Fax: (414) 947-7729; Roger R. Mayer, president; a,b,c,d,e

Praegitzer Industries
1270 Monmouth Cut-Off, Dallas, OR 97338; Tel.: (503) 623-9273 Fax: (503) 623-5438; Jim McCain, general manager; d

Teledyne Lewisburg
1425 Higgs Rd., Box 326, Lewisburg, TN 37091; Tel.: (615) 359-4531; Fax: (615) 359-2085; John Murphy, business development manager; a,b,c,d,e

The JPM Co.
Route 15 North, Lewisburg, PA 17837; Tel.: (717) 524-8200; Fax: (717) 524-8181; Dick Krass, director marketing and sales; a,d,e

TII Industries Inc.
P.O. Box 433, Toa Alta, Puerto Rico 00954; Tel.: (809) 870-2700; Fax: (809) 870-2512; Alan Hotaling, VP and general manager; b,c,d,e

Varian Tempe Electronics Center
615 South River Rd., Tempe, AZ 85281; Tel.: (602) 968-6790; Fax: (602) 894-5381; Douglas Kim, marketing manager; a,b,c,d

XCEL Corp.
4290 East Bickll St, Ontario CA 97617; Tel.: (714) 391-4321 Fax: (714) 391-4558; Sam Calvillo, director sub-systems engineering and mfg.; a,b,c,d

XETEL Corp.
8100 Cameron Rd., Suite 150, Austin, TX 78759; Tel.: (512) 834-2266; Fax: (512) 834-9250; Mark Trutna, director sales; a,b,c,d

Type of service

- **a** Design
- **b** Product assembly
- **c** Testing
- **d** Turnkey manufacturing
- **e** Cable and harness assembly

$5 million to $20 million

4th Generation
4 Pheasant Run, Newton, PA 18940; Tel.: (215) 968-5700; Fax: (215) 968-6094; Tony Tartaglia, VP; a,b,c,d,e

Altek Co.
245 East Elm St., Box 1128, Torrington, CT 06790; Tel.: (203) 482-7626; Fax: (203) 496-7113; Stephen Altschuler, president; a,b,c,d,e

Altron Inc.
6700 Industry Ave., N.W., Anoka, MN 55303; Tel.: (612) 427-7735; Fax: (612) 427-3980; Alan Phillips, president; b,c,d,e

Bibco Inc.
326 East Main St., Benton Harbor, MI 49022; Tel.: (616) 925-8445; Fax: (616) 925-3081; Paul Pantaleo, sales manager; b,c,e

Cerberus Pyrotronics
8 Ridgedale Ave., Cedar Knolls, NJ 07927; Tel.: (201) 397-7272; Fax: (201) 397-7008; Peter Mango, sales representative; b,c,d

Colt Technology Corp.
15301 W. 109th Street, Lenexa, KS 66219; Tel.: (913) 888-1673; Fax: (913) 888-3666; Jeffrey S. Lynn, marketing and sales manager; a,b,c,d,e

Continental Testing Laboratories
8385 South U.S. Highway 17-92, Fern Park, FL 32703; Tel.: (407) 831-2700; Fax: (407) 260-2053; Brian Hickey, marketing manager; c

Diagnostic Instrument Corp.
4 Copeland Dr., Box J, Ayer, MA 01432; Tel.: (508) 772-4572; Fax: (508) 772-5210; James Hashem, president; b,c,d,e

E. I. (Ireland) Company Ltd.
Shannon, County Clare Ireland; Tel.: (353) 61-61277; Fax: (353) 61-61053; Mike Guinee, chief executive; a,b,c,d

Electronic Engineering Research
20845 Prairie St., Chatsworth, CA 91311; Tel.: (818) 709-1195; Fax: (818) 709-1377; H. Lawrence Medley, VP, director marketing; b,c,d,e

Electronics Systems Inc.
Box 5013, Sioux Falls, SD 57117; Tel.: (605) 338-6868; Fax: (605) 338-5061; Leo Reynolds, president and CEO; b,c,d

Express Manufacturing Inc.
3115 West Warner Ave., Santa Ana, CA 92704; Tel.: (714) 556-1878; Fax: (714) 556-0575; C.P. Chin, president; a,b,c,d,e

Force Inc.
825 Park St., Christiansburg, VA 24073; Tel.: (703) 382-0462; Fax: (703) 381-0392; Wendell Hensley, VP marketing; a,b,c,d

General Technology Corp.
6816 Washington N.E., Albuquerque NM 87109; Tel.: (505) 345-5591; Fax: (505) 344-3227; Ralph Anderson, president; a,b,c,d,e

Kimchuck Inc.
Commerce Park, Corporate Dr., Danbury, CT 06810; Tel.: (203) 790-7800; Fax: (203) 797-8976; Robert Glen, sales manager; a,b,c,d,e

Leetron Inc.
455 Industrial Dr., Warwick, RI 02888; Tel.: (401) 737-8250; Fax: (401) 732-0240; Norman Rena, executive VP; a,b,c,d,e

LMC
101 Gordon Dr., Lionville, PA 19353; Tel.: 1 (800) 628-3028; Fax: (215) 363-3081; Pat Tucci, senior VP sales and marketing; a,b,c,d

MEP Controls
312 Rising Sun Rd., Bordentown, NJ 08505; Tel.: (609) 298-7303; Fax: (609) 298-1982; Hank DelGatto, president; a,b,c,d

Micro Industries
8399 Green Meadows Drive, N., Westerville, OH 43081; Tel.: (614) 548-7878; Fax: (614) 548-6184; Michael Curran, general manager; a,b,c,d

Milwaukee Electronics Corp.
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1-800-227-4712
U.S. Computer
305-477-2288
Wyle Laboratories
1-800-289-9953

CONTRACT MANUFACTURING

Type of service
a Design
b Product assembly
c Testing
d Turnkey manufacturing
e Cable and harness assembly

MiNT Corp.
2650 E. Elvira Blvd., Tucson, AZ 85706; Tel.: (602) 741-6468; Fax: (602) 741-6419; Bo Mrozowski, sales director; a,b,c,d

MLI Industries Inc.
3 East Main St., Apalachin, NY 13732; Tel.: (607) 754-5800 625-216; Fax: (607) 625-2011; Michael MacKenzie, executive VP; b,c,d,e

National Telephone and Electronics Inc.
2350 NW 96th Ave., Miami, FL 33172; Tel.: (305) 592-0551; Fax: (305) 599-0948; J. Ardolino, president; a,b,d,e

Pine Instrument Co.
101 Industrial Dr., Grove City, PA 16127; Tel.: (412) 458-6391; Fax: (412) 458-4648; David Savage, marketing manager; a,b,c,d,e

Precision Graphics Inc.
59 LaGrange St., Raritan, NJ 08869; Tel.: (201) 707-8880; Fax: (201) 707-8884; Robert Weissman, president; a,b,c,d,e

QPL Electronic Dist. Inc., Cable Tek Div.
22 Terry Ave., Burlington, MA 01803; Tel.: (617) 229-2424; Fax: (617) 273-5075; Michael Shaw, president; c,d,e

aRaCoAmo
4100 Burns Road, Palm Beach Gardens, FL 33410; Tel.: (407) 626-7262; Fax: (407) 627-6753; Edward Yonkers, quality manager; a,b,c,d,e

RAMP Industries Inc.
1 North Floral Ave., Binghamton, NY 13905; Tel.: (607) 729-5256; Fax: (607) 729-2977; Charles Faciszewski, sales manager; b,c,d,e

Senior Systems Technology, Inc.
20150 Sunburst St., Chatsworth, CA 91311; Tel.: (800) 800-0778; Fax: (818) 998-0664; Joe Candella, president; a,b,c,d,e

Superior Manufacturing Co.
3133 West Harvard St., Santa Ana, CA 92704; Tel.: (714) 540-4605; Fax: (714) 540-4542; Jim Van Landingham, marketing manager; a,b,c,d,e

SYNTEC Corp.
2201 Donley Dr. Suite 100, Austin, TX 78758; Tel.: (512) 835-4295; Fax: (512) 835-4526; Rodger Schmitt, general manager; b,c,d,e

Thai Micro Systems
2350 Mission College Blvd., Suite 480, Santa Clara CA 95054; Tel.: (408) 982-3807, Fax: (408) 988-3889; Jim Harvey, sales manager; b,c

Tidewater Associates
3101 Whipple Rd., Suite 27, Union City, CA 94587; Tel.: (415) 487-5650; Michael Gifford, director marketing and sales; a,b,c,d

Turtle Mountain Corp.
380 Oak Grove Parkway, St. Paul, MN 55127; Tel.: (612) 481-1427; Fax: (612) 481-7253; Van Barkus, sales manager; b,c,d,e

Vern Kiebler Electronics Inc.
201 North Gables Blvd., Wheaton, IL 60187; Tel.: (708) 668-5407; Fax: (708) 462-7590; Bill Archbold, VP marketing; a,b,c,d,e

Western Reserve Electronics Inc.
2150 Highland Rd., Twinsburg, OH 44087; Tel.: (216) 425-4951; Fax: (216) 425-4956; Robert Rhodes, manager marketing and sales; a,b,c,d,e

Zercom Corp.
Zercom Dr. Box 84, Merifield, MN 56465; Tel.: (218) 765-3151; Fax: (218) 765-3900; Jeff Zernov, president; a,b,c,d,e

Under $5 million

Acap Systems, Advanced Products and Technologies
306 River St., Haverhill, MA 01832; Tel.: (508) 374-8282; Fax: (508) 374-8183; Val Francisco, VP marketing; b,c,d,e

Accurate Electronics Corp.
169 South Abbe Rd., Box 1287, Elyria, OH 44035; Tel.: (216) 366-6330; Fax: (216) 366-0522; R.B. Seybold, VP; b,

Aerospace Industries Inc.
2101 Front St., Cuyahoga Falls, OH 44221; Tel.: (216) 928-5002; Fax: (216) 928-5283; David Harry, sales and marketing; b,c,d

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CONTRACT MANUFACTURING

Argo Electronics Inc.
5054 Bleecker Street, Baldwin Park, CA 91706; Tel.: (818) 962-8422; Fax: (818) 960-7312; Gerd Gleim, VP; b,c,d,e

Automation Electronics
9640 Topango Canyon Place, Bldg. J, Chatsworth, CA 91311; Tel.: (818) 998-5124; Fax: (818) 998-6654; Robert Aiani, Q.C. engineer; b, e

Beta Industries Inc.
2860 Culver Ave., Dayton, OH 45429; Tel.: (513) 299-7385; Fax: (513) 299-0468; Tom Biel, electronics manager; a,b,c,d,e

Branmag Inc.
908 Niagara Falls Blvd., North Tonawanda, NY 14120; Tel.: (716) 693-5994; Fax: (716) 856-4802; Branko Veljkovic, president; a,b,c,d,e

'C' Enterprises
310-110 Via Vera Cruz, San Marcos, CA 92069; Tel.: (619) 744-8182; Fax: (619) 744-1659; Steve Rosoff, president; e

Cable Concepts Inc.
30 Perseverance Way Hyannis MA 02601; Tel.: (508) 771-7782; Fax: (508) 778-5771; Judy Cash, sales manager; b,c,d,e

Type of service
- **a** Design
- **b** Product assembly
- **c** Testing
- **d** Turnkey manufacturing
- **e** Cable and harness assembly

CAD Engineering and Assembly Inc.
8663 Tyler Blvd., Mentor, OH 44060; Tel.: (216) 255-7744; Fax: (216) 255-5900; Frank Novak, president; a,b,c,d,e

Da[illegible]P Manufacturing Inc.
32 [illegible]amilton St., PO Box 107, Chalfont, PA 18914; Tel.: (215) 997-1200; Fax: (215) 997-1200; Gunther Diefes, president; a,b,c,d

DARE Electronics Inc.
3245 South County Rd., 25-A, Troy, OH 45373; Tel.: 1 (800) 366-327[illegible]; Fax:; Paul Gilmore, sales/applications engineer; a,b,c

Data Signal Inc.
2403 Commerce Lane, Albany, GA 31708; Tel.: (912) 883-4703; Fax: (912) 884-4766; William Sanders, president; a,b,c,d,e

Dunham Industries Inc.
17791 Skypark Circle, Suite D, Irvine, CA 92714; Tel.: (714) 261-2308; Fax: (714) 724-1610; Robert Dunham, president; b,c,d,e

E.C.M. Inc.
1515 West 259 St., Harbor City, CA 90710; Tel.: (213) 530-3456; Fax: (213) 530-9161; Wes Kirchoff, president; a,b, e

Edbeth Enterprises
South Park Plaza Spur 239, Del Rio, TX 78840; Tel.: (512) 774-4672; Ed Snyder, manager; a,b,c,d

Electra-ssembly
P.O. Box 30, 80 Cutler St., Warren, RI 02885; Tel.: (401) 245-5493; Richard Rosa, president; a,b,c,d

Electro-Support Systems
43445 Business Park Drive Suite 108, Temecula, CA 92590; Tel.: (714) 676-2751, Fax: (714) 694-0097; Bob Silcott, president; a,b,c,d,e

Electronic Professional Services Inc.
26351 Curtiss-Wright Pkwy, Cleveland, OH 44143; Tel.: (216) 289-4115; Fax: (216) 289-4116; Jack Bliss, business development manager; a,b,c,d,e

EPS Inc.
26351 Curtiss-Wright Parkway, Richmond Heights, OH 44143; Tel.: (216) 289-4115, Fax: (216) 289-4116; Jack C. Bliss, business development manager; a,b,c,d,e

Eveready Industry Corp.
2085 Zanker Road, San Jose, CA 95131; Tel.: (408) 943-1555; Fax: (408) 943-1248; John Jeng, director engineering; b,c

Griffin Ltd.
1720 - J. Belmont Ave., Baltimore, MD 21207; Tel.: (301) 298-1710; Fax: (301) 265-8404; K.C. Goldstein, president; a,b,c,d,e

Halcyon Microelectronics Inc.
5467 Second St., Irwindale, CA 91706; Tel.: (818) 814-4688; Fax: (818) 960-8133; Dennis P. Martin, president; a,b,c,d

Hutronix Inc.
2400 S. 34th Place Box 27566, Tucson, AZ 85726; Tel.: (602) 790-5348; Fax: (602) 790-8836; Robert Del Ghiaccio, VP marketing/sales; b,d,e

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CONTRACT MANUFACTURING

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Box 5238, 540 N. Commercial St., Manchester, NH 03108; Tel.: (603) 669-5224, Fax: (603) 669-1571; Frank Haigh, director marketing/sales; a,b,c,d

Kurt Manufacturing Co., Electronics Div.
211 St. Anthony Blvd., NE, Minneapolis, MN 55418; Tel.: (612) 572-4415; Fax: (612) 789-7859; Jeff Lenz, manager of electronics division; a,b,c,d,e

Libra Industries Inc., Electronics Division
7555 Tyler Boulevard, Mentor, OH 44060; Tel.: (216) 951-9777; Fax: (216) 951-8145; Mitchell Bednarek, marketing manager; a,b,c,d,e

MANU-TEC Inc.
415 West Belden Ave., Addison, IL 60101-4933; Tel.: (708) 543-3022; Fax: (708) 543-7766; Richard Zboril, president; a,b,c,d,e

Micropolish
Z.I. des Pradeaux, 13850 Greasque, France; Tel.: (33) 42-699104; Fax: (33) 42-699470; Gerard Gilles, president/CEO; b,

Type of service
- **a** Design
- **b** Product assembly
- **c** Testing
- **d** Turnkey manufacturing
- **e** Cable and harness assembly

Mitech Electronics Corp.
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Quay Corp.
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R and M Electronics
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Radio Television Products Corp.
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Silicon Valley Turnkey
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Is market research any good? Yes, but beware...
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Standards remain elusive in power supply market
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What recession? Sales for Japan's top 50 jumped 19%
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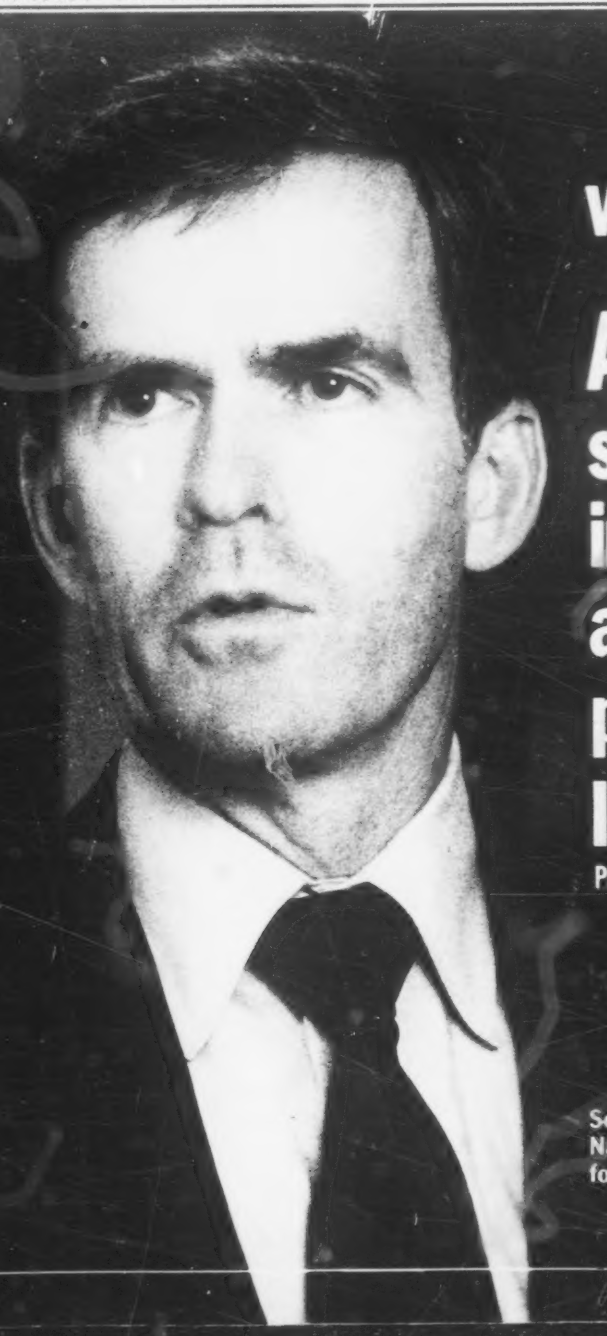
A CAHNERS PUBLICATION

Electronic Business

FOR THE MANAGEMENT TEAM IN ELECTRONICS, COMPUTER AND SYSTEMS COMPANIES-WORLDWIDE
SEPTEMBER 23 1991



WASHINGTON REPORT

★★★★★★★★★

After years of struggle, the U.S. inches toward a technology policy. Is that good?

PAGE 28

Sen. Jeff Bingaman (D-N. Mex.), author of the National Critical Technologies Act, calls for industry-government partnerships

Electronic Business

VOLUME 17, NUMBER 18 FOR THE MANAGEMENT TEAM IN ELECTRONICS, COMPUTER, AND SYSTEMS COMPANIES WORLDWIDE SEPTEMBER 23, 1991

Cover photo by Howard Davis

PAGE 28 "We need an alliance between government and industry," says Sen. Jeff Bingaman (D-N.Mex.)

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INSIDE BUSINESS

Making Washington a profit center

Managing editor Garrett DeYoung

WILL THE notion of national technology policy ever become politically correct? If so, what should it look like? These are important questions for U.S. companies whose overseas competitors already benefit hugely from such policies. ELECTRONIC BUSINESS looks for answers with this issue's special report on Washington and electronics.

Industrial policy has been anathema to the free-market idealogues of the last two administrations, but the bottom-line—as in tax-revenue—consequences of global competition are softening that stance. As managing editor Garrett DeYoung explains in the cover story, Congress and even the White House are now supporting some specific, low-cost proposals aimed at increasing U.S. electronics competitiveness.

It's easy to blame politicians and bureaucrats for the lack of a national technology policy. Easy and, to a large extent, accurate. But the electronics industry has to take some of the blame; it has worked hard to keep the federal government at arm's length. In fact, a Silicon Valley CEO confides that Washington looks like another planet from where he stands.

But that view is changing, reports West Coast managing editor Hugh Willett. As the political consciousness and involvement of Valley executives is expanding, the electronics lobby is growing as well, although it still has a lot to learn. Contributing editor Willie Schatz tackles that subject with a Washington insider's look at what it could cost your company if you decide to seek the help of an industry lobbyist—or the price you might pay if you don't.

If you choke at the fees of lobbyists, you probably also chafe at the cost of market research. How do you know if you are getting your money's worth? In this issue, senior editor Elizabeth Baatz researches the researchers, showing how well the leading research houses perform and how their customers are banding together to set some research ground rules.

Meanwhile, don't expect an effective national technology policy to resemble an electronics CEO's personal wish list. You won't find immediate help in the form of R&D tax credits or a tax break on capital gains. Look instead for education programs, ways to boost return-on-investment at government labs, and—above all—anything that helps balance the federal budget.

—Contributing editor John Parker

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companies. Schlumberger has reaped profit margins greater than 50%.

Why are these niches so important to the $250 million ATE division? For one, the machines have helped the company sell pricier testers to each of the top 10 Japanese IC makers. But Neil Richardson, vice president of the ATE division's diagnostic systems group, has a more personal crusade: "Everyone is always talking about how the ATE companies have to change their ways to survive. I'm intent on doing something about it."

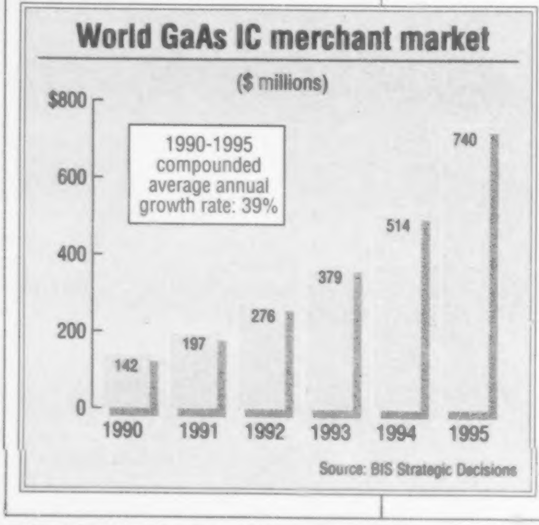
Between the e-beam installed base and users of its new systems, Richardson expects focused ion-beam market to reach beyond $60 million by 1995. The analysts agree. "They've made some nice money in e-beams," says Ken Neff of Prime Data Inc. "If I were them I'd give it one more try."

—By Peter Burrows

SEMICONDUCTORS

Are start-ups poised for GaAs growth spurt?

FOREVER THE technology of tomorrow, gallium arsenide has begun shedding its image as an esoteric and pricey alternative to silicon. At least that's what advocates claim.



World GaAs IC merchant market

Source: BIS Strategic Decisions

Growing demand for the high-speed ICs in certain computer and communications sectors will fuel the GaAs industry to a 39% compounded annual growth rate through 1995, estimates BIS Strategic Decisions.

While that growth is impressive, GaAs won't soon threaten the silicon market. 1990 worldwide sales of GaAs chips totaled just $142 million, says BIS, and 1995 sales will reach only $740 million. In 1990, worldwide merchant silicon chip sales were more than $50 billion.

So far, a few small U.S. companies have driven much of the GaAs development, and they will continue to be key players in the market, claims BIS consultant Richard Endersby.

Three of these small fry merged last May in hopes of cutting overhead while coincidently achieving greater market clout. They include TriQuint Semiconductor, GigaBit Logic, and Gazelle Microcircuits. The now expanded TriQuint claims to be the world's largest commercial GaAs manufacturer and it projects 1991 revenue of about $40 million, according to Louis Pengue, director of marketing communications.

Vitesse Semiconductor also seeks the GaAs throne. It had sales of $17.8 million in 1990, roughly equal to TriQuint's, and Bob Nunn, Vitesse's director of marketing, predicts revenue will double in '91.

Both Pengue and Nunn note their companies compete more with silicon vendors than with each other. For example, more than 50% of TriQuint's business is in the area of digital communications and signal processing while Vitesse produces densely integrated, low-power digital chips for computer applications.

The pioneering GaAs companies believe they have enough time to secure their market niches before the market attracts large manufacturers, such as Motorola, Texas Instruments, and several large Japanese and European chip makers that have active GaAs programs.

—Dwight B. Davis in Seattle

MARKETS

Color printer makers are mostly seeing red

THE BATTLE FOR market share among vendors of low-end color printers, particularly thermal-wax and ink-jet types, is prompting a pricing war that's slashing profits.

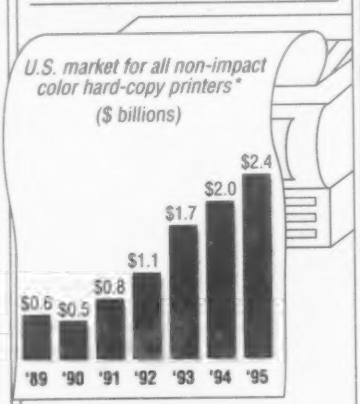
Thermal-wax printer combatants include Tektronix, Seiko, and QMS. Even ink-jet pricing from Hewlett-Packard Co. is falling. End users, of course, are ecstatic.

Prices for non-impact color printers have dropped on the average about 15% in the last six months, and in some segments it's been down 20%, according to Bill Flynn, market analyst, BIS Strategic Decisions.

Profit margin relief may come in the form of newer electro-photographic (E-P) or "true" laser technology which is expected to appear by 1993. E-P essentially affixes dry toner to a page using scattered beams representing different colors.

Flynn says there is only one U.S. vendor, Naples, Fla.-based Colorocs Corp., shipping a laser-emitting diode E-P printer. Others—HP, Canon, and Xerox among them—are expected to follow with introductions in the next year. BIS estimates revenue from sales of E-P printers will jump from $24 million in 1990 to $71 million this year, then climb to nearly $170 million by the end of 1992. By 1995 the firm expects sales of E-P printers to reach $900 million, nearly a third of the total revenue for all color printers.

"There'll be less than 30,000 shipped this year, but it will really start to take off next year," says Flynn, adding that he figures a



The color of money

*Does not include sales of dot matrix and pen-plotter printers

Source: BIS Strategic Decisions

152.2% calculated annual revenue growth rate for E-P printer shipments through 1995. "E-P will be worth three times the market for thermal by then," he predicts.

—By Dave Webb in San Jose

MARKETING

Compaq ad suits reap PR benefit

COMPAQ COMPUTER is the latest entry into a field of high-tech companies that are using litigation to fight aggressive marketing campaigns by competitors. Some observers even argue the suits produce more PR than offending ads.

Compaq's beef is with several aggressive ad campaigns from Dell Computer, one of which calls its own PC a "Road Warrior" and compares it with Compaq's "Road Worrier." Compaq's fury spans [illegible] continents.

Compaq has filed suit against Dell because of its head-to-head advertising in the United Kingdom, the United States, and most recently, Germany.

Although aggressive comparison ads are proliferating, especially by direct-mail PC suppliers, the concept is still new to the computer industry, says David Versfelt, a lawyer with Donovan Leisure Newton & Irvine.

In the U.K., Dell has been enjoined from publishing ads comparing prices with Compaq's. In the United States, Compaq charges Dell's advertising is false and misleading.

In a more unusual move, Compaq also obtained an injunction against a Dell ad that ran in Germany. The ad, which touted Dell's position in a Datapro survey as "No. 1 in customer satisfaction Europe-wide," violated an obscure German rule requiring that a specific number of German citizens be polled in any survey that is quoted in German advertising.

The Compaq/Dell cases in Germany and the U.K. point out a problem that many marketers will run into as the European Community gels in 1992 and companies begin to advertise internationally. "Europeans have a much more narrow view of comparative advertising," says attorney Rick Kurnit, a partner with Frankfurt, Garbus, Klein & Selz. "Competitors have a better chance to enjoin ads there."

The lawsuits could do more for Compaq than just stop Dell from running ads. One school of thought holds that the plaintiff can get as much advertising value out of the lawsuit as the defendant gets out of the ad campaign. At the same time, Compaq could face a backlash. "That could be a valid concern," says Kurnit, "particularly if the company is spending more money on litigation than on product support."

—By Donna Tapellini in New York

MEDICAL ELECTRONICS

Medical electronics not immune to recession

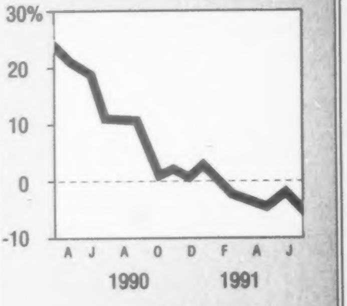
NOT SINCE THE recession of 1974 has the medical instruments industry been so hard hit by a downturn. Unfilled orders for the industry fell during each the first six months of 1991—the longest string of declining backlogs in 16 years, according to the U.S. Commerce Department. For managers more used to burgeoning backlogs, operational shifts to accommodate a slow growth forecast may be difficult.

Medical instruments, a cyclical industry, is used to wild gyrations in sales. Double-digit shipments growth one year often leads to weak sales the next. In the 1986 electronics industry recession, shipments growth slowed to a sluggish 2.2% without adjusting for inflation, followed by 16.5% growth in 1987. Shipments then slumped again to just 0.9% growth by 1989.

In this recession, hospitals are having a hard time making money and so are deferring capital spending. Physicians' demand for advanced instruments coupled with technological advances shielded electromedical equipment makers from the 1989 slump. Shipments of electromedical equipment

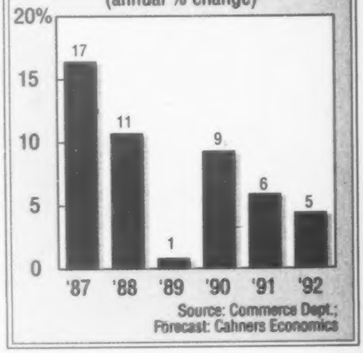
Medical instruments backlogs tumble...

(% change from a year ago)



...squeezing shipments

(annual % change)



Source: Commerce Dept.; Forecast: Cahners Economics grew 15%, after discounting for inflation, in 1988 and again in 1989.

Still, even this robust industry is weakening. Commerce estimates shipments growth slowed to 8% in 1990 and will grow again around that rate in 1991. During the five-year period ending 1995, electromedical instruments shipment will grow at a relatively modest 6% annual rate.

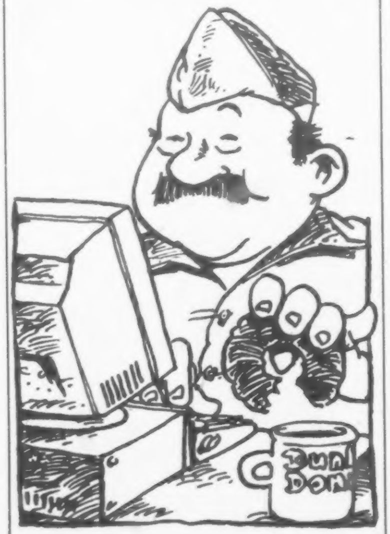
—By Elizabeth B. Baatz

WORKSTATIONS

"Time to manage the database"

COMPETITORS HAVE always said that Sun Microsystems Inc.'s sales strategy is full of holes. This time they may be right.

Dunkin' Donuts Inc. of Randolph, Mass., is using Sun's new entry-level SparcStation ELC workstation to manage its Oracle database running on a SparcServer 490 fileserver—hardly a piece of cake for a company which this year is expected to sell one billion doughnuts in 44 states and 16 countries and adds 200 franchises every year. MIS director Dave Bennett says that Dunkin' Donuts chose the ELC over PCs because of the workstation's horsepower and multitasking capability.



Sun's effort to push sales of its workstations beyond the scientific/engineering arena into commercial applications is now reaching such wide-ranging markets as health care, education, airlines, and, of course, doughnuts.

Sun also reports that it has sold SparcStation ELCs to Healthcare Affiliated Services of Pittsburgh for maintaining patient records; to Yale University for use by faculty and students; and to Northwest Airlines for tracking ticket sales. Overall, commercial applications now account for about 30% of Sun's sales. And because the SparcStation ELC's entry price is below $5,000, Sun is counting on the new workstation to boost its sales into commercial markets.

—By Rick Whiting

INTERNATIONAL

New study rates European nations as business sites

WHEN IT COMES time to set up shop in Europe, U.S. executives have traditionally set their sights on English-speaking or highly industrialized regions. A recent study concludes, though, that Italy, Spain, Greece, and Portugal are also attractive sites.

The central part of Spain, for instance, has "a large, educated work force with a high level of growth and productivity," according to New York-based Ernst & Young, which rates 64 European regions on labor, transportation, taxation, financial incentives, and other variables.

"Each company has its own requirements for a headquarters, assembly plant, or distribution center," says Jim Searing, E&Y's director of international business services. But while electronics companies are attracted to France, Germany, and the U.K., he says, those seeking to set up a European site should look farther afield. Certain regions, he notes, offer cash incentives to companies that locate in their vicinity. But those incentives often aren't free. Some regions link them to the number of jobs created. The European Commission, moreover, may want to limit such incentives in certain areas.

Ireland features low taxes and few labor disputes, making it attractive for manufacturing and assembly. The country's high unemployment rate makes for a motivated work force and low wages. Major drawback: security.

Northern Italy is cited for high-tech manufacturing expertise. Regions south of Rome get high marks for low taxes and labor costs and high government incentives. But layoffs are expensive: They must be negotiated with the government and employees are paid until a settlement is reached.

E&Y cites a plentiful supply of low-priced labor in Spain, low property costs, and generous financial incentives. Seville and northern Spain are highly rated as manufacturing sites.

Belgium, the Netherlands, and Luxembourg rate highly for central location, good transportation, and low property costs. Brussels is cited for its service sector organizations and, with the Netherlands, as a site for R&D and distribution.

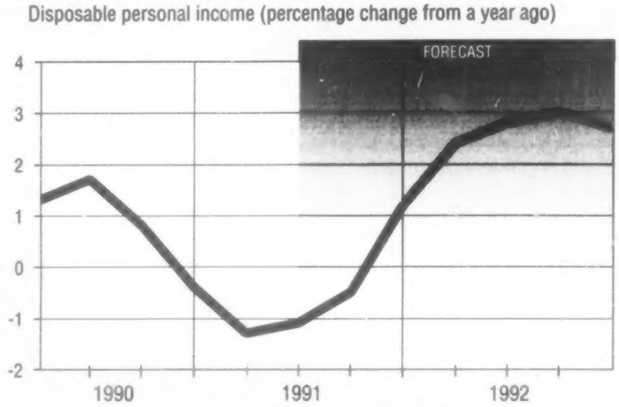
Scotland's Silicon Glen serves as a manufacturing site for chips, computers, and PCBs. Scotland also boasts 200 software companies and one of the world's top AI research centers. Scotland's location on the U.K.'s periphery makes distribution a challenge, although the Scottish Development Agency and industry are working to rectify that.

Sometimes the final decision has little to do with quantitative measures. One U.S. exec chose Belgium for his company's headquarters, even though his advisers had pushed for London. The executive and his wife wanted to bring their two cats, and Britain requires a six-month quarantine on imported animals.

For more information on the E&Y study, call (212) 773-6555.

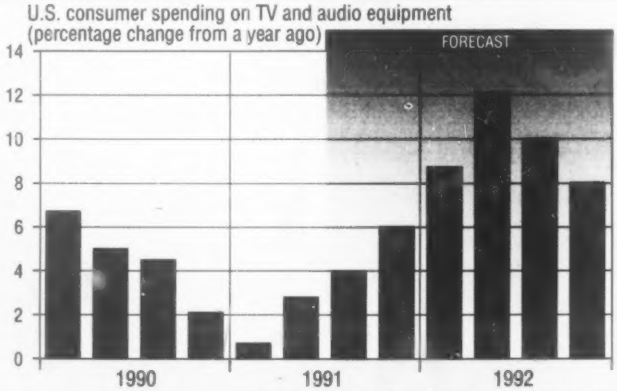
—By Barbara Jorgensen

When consumers' wallets get a bit fatter...



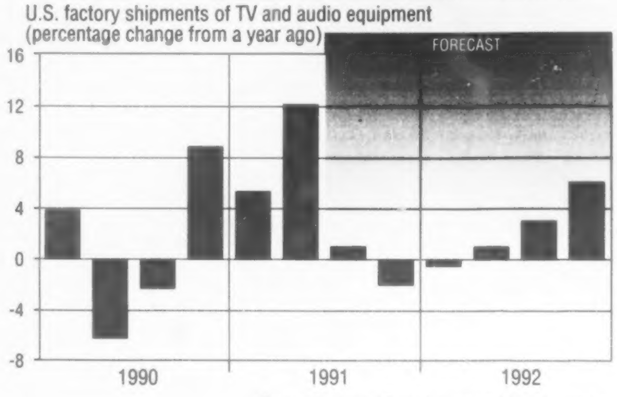
Source: Commerce Dept., forecast: Cahners Economics

...consumers will buy more home electronics...



Source: Commerce Dept.; forecast: Cahners Economics

...but U.S. manufacturers don't expect a boom



Source: Commerce Dept.: forecast: Cahners Economics

Consumer electronics still feels the pinch

ALTHOUGH CONSUMER electronics sales showed surprising strength during the recession relative to other consumer markets, manufacturers and importers are still pinched by the nation's economic slowdown. Shipments of household audio and video products by U.S. manufacturers fared well in the first quarter of this year, climbing 5.3% over year-ago levels to $2.24 billion. Shipments hit $2.45 billion during the second quarter, a rise of 12.1% from the year-ago level.

Manufacturers looking for a rebound in the coming months will be disappointed, however. The nation's unemployment rate climbed from 5.2% in June 1990 to 7% in June 1991 and will remain high until the nation's production rate begins to expand more vigorously. As a result, disposable personal income has suffered since the second quarter of 1990. That, combined with a high rate of personal debt, will inevitably cut into the growth potential of consumer electronic sales.

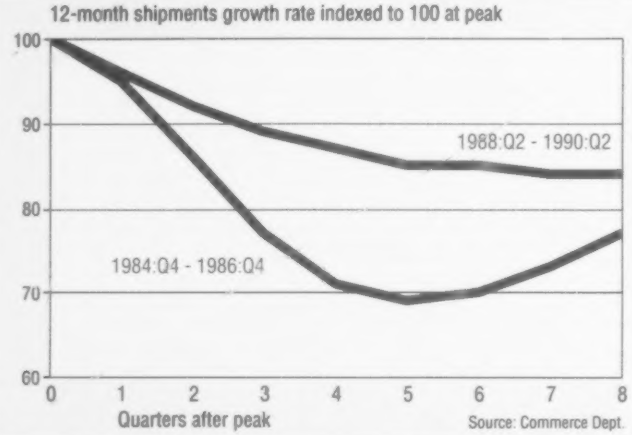
While U.S. makers of audio and video equipment saw sales rise, total U.S. consumer electronics spending advanced only 4.5% in 1990, the lowest one-year gain since 1980. Spending rose just 0.7% in the first quarter and 2.8% in the second quarter of 1991 compared with the same periods of 1990.

Cahners Economics' forecast for consumer spending on audio and video equipment calls for a mild 3.1% increase in 1991 before recording a healthier gain of 10% in 1992. Sales of domestically produced consumer electronics are expected to slow to 3.9% in 1991 and 2.4% in 1992.

—by John Farrell

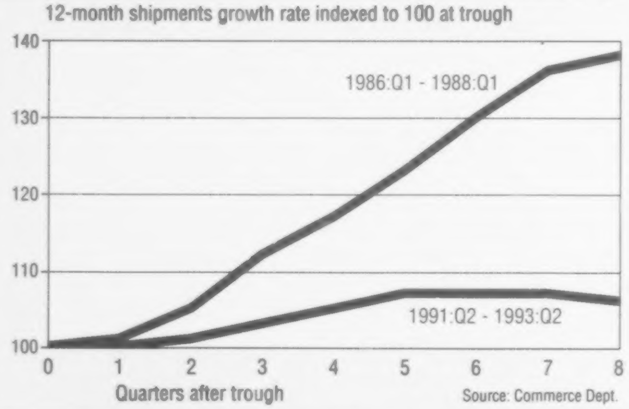
For more information on Cahners Economics' forecasts, write Dan Buchan at 275 Washington St., Newton, MA 02158; call (617) 630-2105; or fax (617) 630-2100.

This components recession was milder...



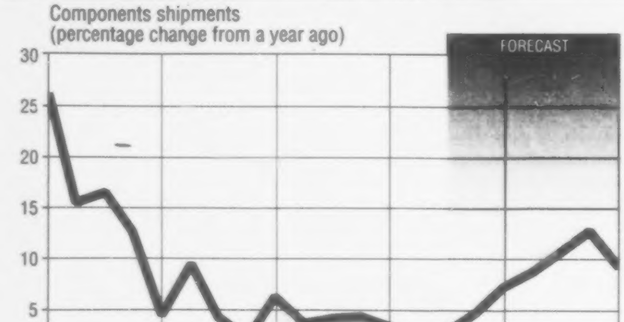
Source: Commerce Dept.

...and the coming recovery will be more muted...



Source: Commerce Dept.

...so don't expect to match the '88 pace



Source: Commerce Dept.; forecast: Cahners Economics

Component shipments grow ever so slowly

AFTER THREE YEARS of weakening sales growth, electronic component manufacturers finally got some relief this past spring. U.S. factories shipped $15.9 billion worth of active, passive, and electromechanical devices in the second quarter of 1991, a 3.7% increase above the first quarter and 2.6% higher than a year ago.

As expected, this recession has remained much milder than the 1986 slump, when electronic component shipments fell 11.5% during the 12 months ended March 1986 compared with the previous 12-month period. This time around, shipments squeaked out a 2.5% growth for the 12 months ended June 1991—what now appears as the business-cycle low for this recession.

A milder slowdown this time will translate into a more moderate rebound in 1992. During the last expansionary period of 1987 to 1988, component shipments growth climbed to a peak rate of 23.5% in the 12 months ended May 1988. Shipments growth this time is expected to peak in the fourth quarter of 1992 but will top off at a growth rate of just 10%.

One reason the current recovery will be more muted than in previous years is better inventory control. Prior to the 1985 slowdown, manufacturers kept nearly 2.5 months of inventory on hand. In the current downturn beginning 1989 component factories stocked only 1.9 months of inventories.

With the slowdown finally over, manufacturers are now gearing up for the recovery. While some companies will feel the recession's effects longer than others due to international competitiveness, different product lines, and geographic location, the industry as a whole is expected to see demand rise in every quarter this year and next.

—By Julie Handelman

The buyer's guide to market research

Defining your forecasting needs will help you decide how and where to buy research and how to get your money's worth

By Elizabeth B. Baatz

If you remember the electronics euphoria of 1984, then you also remember how the bubble burst in 1985. Why didn't any of the high-powered, high-priced market researchers kicking around at the time warn us?

The honest answer is that few, if any, of the supposed soothsayers saw the crash coming. Despite what the market forecasters themselves tell you, in fact, predicting the future of electronics markets isn't a science at all, and most forecasts are just as likely to be wrong as right.

So why do so many companies continue to buy them? Why are there so many different types of market research firms? How do they differ from each other? How do you know which one best meets your specific needs? And what should you know about research methods and questionable practices *before* signing the check?

To be fair, much of the research community's bad rap is due to the very nature of forecasting the growth of new technologies. Since there often is little historical data on these technologies, there is no reliable statistical model that can be used to predict their futures. Forecasts for high-definition television, for example, depend on so many assumptions—on pricing, technical standards, the rate of user acceptance, etc.—that any market forecast is risky.

New technologies also are tough to call because no one can even agree on how to define emerging markets. In the late 1970s, for example, estimates of the ASIC market ranged from as low as $100 million to as high as $2 billion. The huge difference was due to definitions—in the former estimate, only gate arrays were included.

Even forecasts for older, slower-changing market segments (PCs, for example) are more likely to be wrong now than 10 years ago. The reason is that demand for many of those products was at one time powerful enough to override economic trends and other mitigating factors, and a straight-line forecast based on early market performance could be reasonably accurate. Now that the industry is more mature and more closely tied to the overall economy, such forecasts are less accurate.

Market forecast data can be wrong for other reasons too. Some buyers of market research contribute to the problem by forming close relationships with just one market researcher to whom the company then pitches its wares. Little wonder that one hears complaints when the researcher fails to deliver objective market data. In other cases, buyers deliberately or inadvertently promote unreliable data by expressing less interest in obtaining accurate numbers than in acquiring a favorable forecast to convince Wall Street that a company is in the right market. In such cases, research firms simply serve as "cheerleaders" by producing overly optimistic reports.

Occasionally, the tricks of the consultants' trade border on the unethical. One such gimmick is "double-dipping"—conducting a proprietary custom research project for one client and then selling it elsewhere. Another is to take an old report, tinker with it, and re-issue it as a new study—a common practice during the final troubled years of the now-defunct Gnostic Concepts.

BUYERS OF MARKET research also may be confused by the shopping-center variety of suppliers, each of which fills different market needs. Some are like K Marts, offer-

ing noncustom reports for $500 to $1,000 each. These reports are often written by ghost researchers, which means the quality of their reports could be questionable. In fact, magazines such as ELECTRONIC BUSINESS frequently receive calls from these researchers looking for information.

These researchers, however, are actually more like publishers of data. Their forecasts are often too optimistic and should be used carefully. Remember that good news sells reports, and the job of a publisher of research is to sell as many reports as possible. But if you merely need an overview of a market, these noncustom reports—available from New York-based Frost & Sullivan, for example, or San Jose-based Market Intelligence Research Co.—are often reliable enough for your purposes and may be less expensive than doing the research yourself.

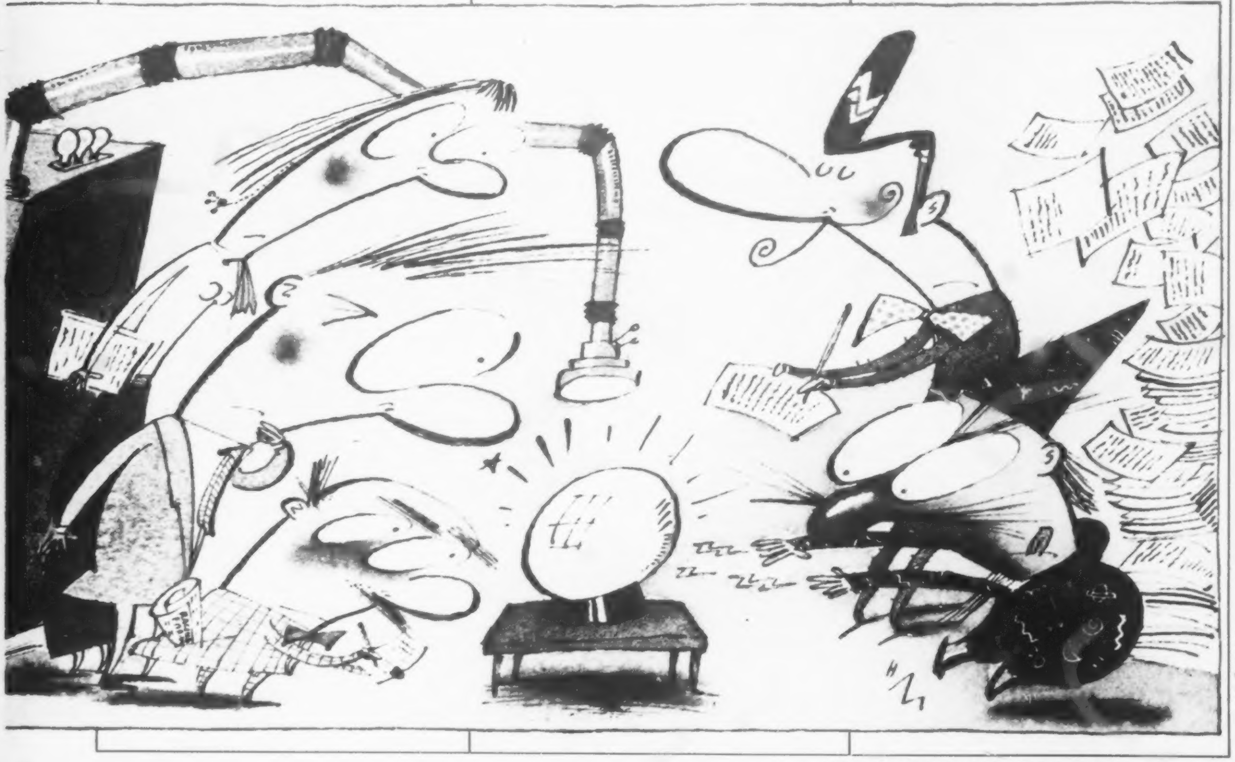
Other companies, such as Dataquest in San Jose and International Data Corp. (IDC) in Framingham, Mass., can be compared to Sears. They too offer a variety of studies, but they are compiled mostly by inhouse analysts, and the quality is generally higher than the "K Mart" offerings. The forecasting service, often sold as a subscription, also is more expensive—$10,000 to $50,000.

Research firms sometimes serve as "cheerleaders" by producing overly optimistic reports

Large management consulting and accounting firms that do not specialize solely in computers or high-technology, such as Arthur D. Little and The Boston Group, charge big bucks for custom studies. Some companies—Dataquest, InfoCorp., and IDC, for example—specialize in generating numbers; others—Arthur D. Little, Medigroup, and the Gartner Group—are especially strong in market analysis and strategy. "The Gartner Group is a strategy company; I would never use their numbers," says Shari Morwood, senior market research consultant at Hewlett-Packard Co. "They make up their numbers based on their experience and things they've read."

Lastly are the specialty shops that focus on a particular market—VLSI Research for semiconductor equipment, Rose Associates for electronic materials, Stanford Resources for displays, Prime Data for instruments—and the less expensive, less well-known "mom 'n pop" shops. Of sometimes questionable quality, these latter companies are especially plentiful during recessions, when market research departments have been cut and an analyst with 25 years' experience sets up shop with a bundle of contacts.

To help sort out the differences between the various researchers, some



Hal Mayforth

Do-it-yourself forecasting

ONE OF THE MOST interesting trends in producing more accurate market research for electronics and computer industries is the use of new software that uses the industry's own information-processing power. One example is provided by John Crosby, formerly in charge of semiconductor operations for Western Digital and now president of Forecast Systems Inc. of Prescott, Ariz. For years, says Crosby, he dealt with "ill-conceived, ill-designed top-down forecasts," in which a company's forecast is driven by macroeconomic variables.

Noting the trend in the electronics industry toward partnering and strategic alliances between suppliers and customers, Crosby's software allows users to forecast their companies' needs based on data and forecasts from their suppliers and customers. Merged with existing top-down forecasts, such software offers industry executives an alternative to traditional market forecast data.

Companies with a strong command of their markets can even become sources for market researchers. "We've been the closest to the technology in our industry [robotic applications]," says Denise Dillon Harris, manager of marketing services at Precision Robots Inc. in Billerica, Mass. "So Dataquest has actually been calling us to learn about the market." □

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larger electronics companies have allocated staff resources for evaluating, negotiating, and buying market research. Every year, for example, Hewlett-Packard publishes its internal *Guide to Syndicated Market Research*, which profiles and ranks the top 100 researchers. The providers are ranked on 60 different dimensions, says Morwood, including cost, accuracy, timeliness, methodology, and ethics.

WITH SO MANY TYPES of research firms to decide among, how do you make the right choice? The answer: Ask lots of questions. Users and market researchers alike note that the most important question is, What do you want to do with the research? Once you know your objective, you can narrow your choices.

Next, you should determine what the research is worth to you. "There are a lot of bright, presentable, witty people in this industry," says IDC senior vice president Aaron C. Goldberg. "If you want to buy interesting chat from a person, then buy it, but pay accordingly. The idea that someone can get $5,000 to $8,000 for an afternoon's work is ridiculous." If the fee is too steep, see if you can negotiate a customized subset of the subscription. That way, instead of paying $30,000 for the entire service, you pay only $10,000 for the part you really want.

Ask for references. Check out the experiences of other companies in your market. While a high-priced researcher in no way guarantees quality, going for bargains can also be a mistake. "Buying research is like buying attorneys or any other service," advises management consultant Tom Burke of Wayland, Mass., himself a frequent user of research. "If you don't appreciate the extra dimension that a researcher brings to a project, then you may mistakenly go for the lowest price."

> **If you want to buy interesting chat from a person, then buy it; but pay accordingly**

Ask for forecast track records and examine them carefully. Track records can be jury-rigged. Check to make sure the date of the original forecast has been noted; you want a track record that shows what the forecaster said *before* the data was tallied. "Every analyst out there has been right at some time and they will advertise it," warns Michael Gimball, director of market research for Harris Semiconductor Corp. Gimball keeps his own records of the forecasters' accuracy over time.

Finally, ask for a good explanation of the research methodology. If it seems like smoke and mirrors or if the methods are "top secret," search elsewhere. "The guy who has a secret model that he won't release to the world is a quack," says Dan Hutcheson, president of VLSI Research in San Jose. "There are no secret models. What is proprietary is the forecaster's intelligence in using the models."

ONE COMMON PROBLEM in buying market research comes from knowing who you really are buying from. Top consulting companies such as Dataquest, IDC, and the big accounting firms admit to using subcontractors to help prepare some studies. "The large electronics companies [that buy the studies] like the big name and comfort of the large, well-known consulting companies," says independent consultant Phil Lapin, a printed circuit board specialist in Florence, Ore., who has worked for several major U.S. consulting firms that lacked resident staff experts. The research companies themselves insist that the use of outside contractors in no way compromises their quality standards, and sometimes that's true.

But clients that fail to ask whether the relevant expert is a full-time staff member or a subcontractor may miss an opportunity to hitch up with a less expensive, and perhaps just as reliable, independent researcher for future work. The savings can be considerable. In most cases, large

Forecasts reported by ELECTRONIC BUSINESS ... and how they did

Rese[illegible]any	Issue date	Market	1990 Forecast	1990 Actual
Integrated [illegible] Engineering	7/1/85	Worldwide gate array market	$2.2 billion	$3.5 billion
Henderson Ventures	12/10/85	U.S. electronic equipment production	309.7 billion	218.3 billion
Electronic Industries Association	1/15/86	Electronic content for U.S. DOD budget	56.5 billion	55.3 billion
Probe Research Group	5/15/86	U.S. voice messaging market	840.0 million	810.0 million
International Data Corp.	6/1/86	Worldwide T-1 multiplexer sales	562.4 million	670.0 million
Technology Research Group	10/7/87	Worldwide CAE market	2.5 billion	1.6 billion
Stanford Resources Inc.	11/15/87	Worldwide flat panel display sales	2.9 billion	3.2 billion

Source: ELECTRONIC BUSINESS

Tracking down the actual 1990 data for markets that were forecast three or more years ago was no easy task, but here's a random look at some forecasts we published years ago and how they actually did. In order to avoid definitional problems, forecasts are compared with actual data released by the original source. Frost & Sullivan and Dataquest, two forecasters that appear frequently in the pages of ELECTRONIC BUSINESS, were unable to provide us with comparable data

consulting firms that use outside talent for a study charge the buyer at least three times what they pay the subcontractor.

None of this implies that market-research companies are an endangered species. Most observers concede that at least some of the complaints about the forecasters are a simple case of killing the messenger. Perhaps the most important point is that it's the buyer's responsibility to minimize the chances of getting burned by knowing precisely what he or she needs and what it's really worth. In that sense, buying market data is basically no different from buying anything else. ☐

Research buyers sei[illegible]rol

ABOU[illegible]R and a half ago, research [illegible] from major computer and semiconductor companies moved to improve the quality of computer-industry data by forming the Computer Market Analysis Group (CMAG). Members hoped that by demanding standardized definitions for market segments, geography, and distribution channels, the research providers would respond with better data. Membership in the group, which is open to any company that sells or makes computers, has grown by word of mouth and now includes IBM, Apple [illegible]mputer, Hewlett-Packard, [illegible]ital Equipment, Sun Microsystems, and Intel, among others.

One of the group's first tasks was to survey the methodologies of major research vendors. When the survey yielded murky answers, CMAG started inviting researchers to their meetings to personally describe their processes. While some researchers sweat bullets at these presentations, the response of the data providers has been "very good," says John Hagens of International Planning and Research Inc. in Philadelphia, the management consulting company that facilitated CMAG.

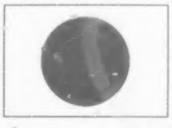
"The honesty has been amazing," says one CMAG member, who recalled that during one such meeting a researcher admitted in front of the group that he got market share data by inviting product managers out for cocktails at the trade shows and taking notes on the back of a napkin.

Other developments in the industry include the formation of the World Microprocessor Statistics Committee, which is modeled after the chip industry's World Semiconductor Trade Statistics program. Once the program is in full swing, the computer industry will finally become more sophisticated in its own data collection efforts by exchanging sales statistics. ☐

Japan's top 50 electronic companies escape recession

Japanese sales spurted 19% last year, nearly three times the rate of U.S. electronics companies

By Paula Doe



JUDGING FROM sales by Japan's biggest electronics companies, it's hard to believe there was a recession or a semiconductor slump last year. The 20 top Japanese electronics companies increased their total electronics sales (expressed in yen) by a whopping 19% in fiscal 1990; the yen's appreciation during the year added another 12% to the dollar value, bringing the companies' electronics sales to $203 billion. By contrast, the top 20 U.S. electronics companies managed to grow their electronics sales by only 7% to reach $199 billion.

Surprisingly, the big growth in Japan didn't come from the giants with the most sophisticated technology in semiconductors and computers. It came largely from companies that continued to make incremental improvements on mundane products such as automotive controls, copiers, and consumer electronics.

The hot growth electronics company of the year, for example, was automotive components maker Nippondenso Co., best known as a producer of car heaters and air conditioners. The company increased its yen-based sales of electronics products by 32%, to the equivalent of $3.3 billion. Most of the growth came from soaring sales of electronic fuel-injection systems to its affiliate Toyota Motor Corp. But the company is also doing well in bar code scanners.

Copier makers Canon Inc. and Ricoh Co. also posted strong sales, increasing their electronics revenues by 28% and 2[illegible]%, respectively. In both cases, growth is being driven by booming sales of color and digital copiers. But copiers are just one example of highly successful improvements on old products coming out of these companies. Canon is also doing well with innovations ranging from bubble jet printers to faster auto-focus cameras. Citizen Watch Co. managed to boost revenue by 26% with higher sales of information equipment.

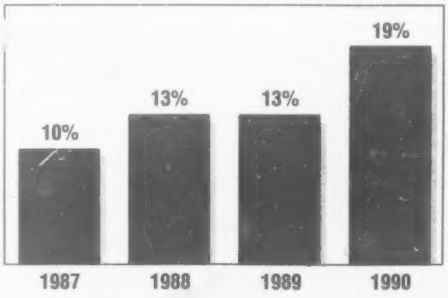
Sony Corp. is yet another company that is flying high on consumer electronics, increasing its electronics revenue by 24%. While Sony's sales of components and information equipment grew the fastest (29%), revenue also climbed by more than 20% in its main audio, video, and television businesses.

Overall, the Japanese electronics companies did better than the rest of the Japanese manufacturers. Altogether, the latter segment increased sales 11% in fiscal 1990, according to a recent survey by *Nihon Keizai Shimbun*. Pretax profits dropped 4%, while net income remained unchanged.

But Japanese electronics didn't escape the recession entirely unscathed. While most of the companies with the biggest sales gains also

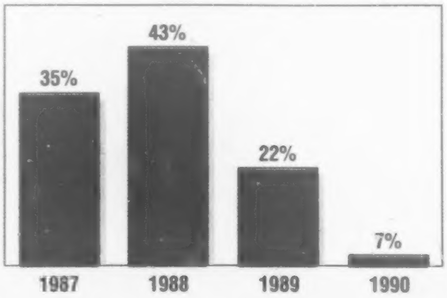
Japan's sales grow smartly...

(Annual change in electronics sales)



...but profits take a big hit

(Annual change in net income)



Based on percentage change, in yen, for top 20 Japanese companies

Source: ELECTRONIC BUSINESS

saw healthy profit increases, overall profit growth slowed. Net income at the top 20 Japanese electronics companies rose by only 7%, compared with a 22% growth the year before and a 26% growth by the U.S. top 20 in fiscal 1990.

THERE WERE SEVERAL reasons for that relatively sluggish performance. One was the slow economy in the United States and elsewhere, which cut demand for exports by some Japanese companies. Some earnings were trimmed by the big depreciation expenses associated with aggressive capital investment in recent years, and the slowdown of Japan's once-booming financial markets also hurt performance, as sharply lower stock prices and interest rates cut the companies' windfall investment and interest income that had been propping up their profits.

Indeed, about one-third of the 50 Japanese companies that had $800 million or more in electronics sales in fiscal 1990 saw profits actually decline, in some cases at a double-digit rate. Big names such as NEC Corp., Sanyo Electric Co., Oki Electric Industry Co., Minolta Camera Co., Konica Corp., and Shimadzu Corp. saw pretax profits drop 20% or more. In fact, industry giant NEC's net income dropped 36% from the year before, slipping to less than 2% of total revenue. The company took losses initially because it withdrew from the audio-visual business in the United States, and then it was further hurt by slumping prices for memory chips and lower earnings from affiliates.

Still, total operating income remained at about 7% of total revenues for the top 20 Japanese electronics companies, and some companies managed to maintain their fat margins. Nintendo Co. and Fanuc Ltd. raked in operating income of roughly 29% of total sales. Component makers also did well. Capacitor maker Murata Manufacturing Co. managed operating margins of 16% of sales, TDK Corp. had 13%, and Kyocera Corp. had 12%.

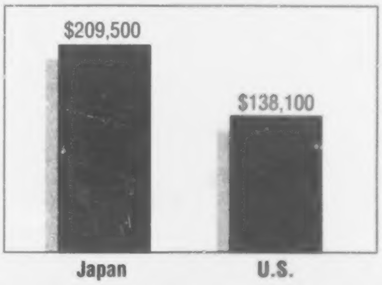
The United States continued to chip away at Japan's traditional productivity advantage. Sales per employee at the top 20 Japanese electronics companies inched up only 3% in fiscal 1990, versus 11% growth at the top 20 U.S. companies.

Why the relatively low productivity gain in Japan despite the higher sales? The main reason is that Japanese companies added so many new workers: Employment at the top 20 climbed 10%, to about 1.2 million. The gains in the United States came from cutting back personnel by about 4% (to approximately 1.5 million) while boosting sales by 7%.

ALL OF THE DATA suggests that U.S. productivity remains only about two-thirds the Japanese level. Sales per employee at the top 20 U.S. electronics companies came to $138,100, compared with $209,500 at their Japanese counterparts. The actual difference is probably somewhat less, however, since Japanese sales in dollars got a boost from the exchange rate and the Japanese data included workers at affiliates that don't show up in consolidated totals. □

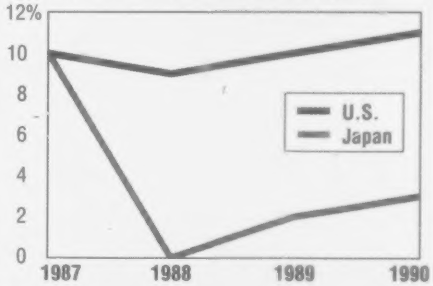
Japan is tops in productivity...

(Average revenue/employee, 1990)



...but U.S. is improving faster

(Annual change in revenue/employee)



Based on data from top 20 electronics companies

Source: ELECTRONIC BUSINESS

Japanese vs. U.S. electronics companies in 1990

	Japanese top 20	% change from 1989	U.S. top 20	% change from 1989
Electronics sales ($ billions)	$203.2	+19	$198.8	+7
Total sales ($ billions)	$252.2	+13	$203.6	+6
Net income ($ billions)	$7.7	+7	$12.0	+26
Net income/revenue	3.0%		6.0%	
Sales/employee	$209.500	+3	$138,100	+11
Net income/employee	$6,400	-2	$8,200	+32

Exchange rate: 141 yen=$1

Source: ELECTRONIC BUSINESS

TOP 50 JAPANESE COMPANIES

1991 Rank	1990 Rank	Company	Electronics sales ($ millions)	% change '91/'90	Total sales ($ millions)	% change '91/'90	Operating income ($ millions)
1	1	**Matsushita**[1]	$33,389	9	$46,804	10	$3,352
2	2	**NEC**	26,233	7	26,233	7	1,522
3	3	**Toshiba**	25,100	17	33,301	10	1,859
4	4	**Hitachi**	22,900	14	54,872	9	3,592
5	5	**Fujitsu**[2]	21,074	17	21,074	17	1,386
6	6	**Sony**	20,461	24	26,176	25	2,110
7	7	**NTT**[2]	15,000	NA	44,337	4	4,421
8	9	**Canon**	12,000	28	12,255	28	1,126
9	8	**Mitsubishi**	11,800	11	23,519	11	1,481
10	10	**Sharp**[2]	9,000	13	10,869	12	539
11	12	**Ricoh**	6,200	26	7,115	20	248
12	11	**Sanyo**	5,331	7	10,611	8	345
13	13	**Oki**[2]	4,687	5	4,687	5	209
14	14	**Pioneer**	4,253	15	4,253	15	513
15	15	**TDK**	3,830	13	3,830	13	483
16	22	**Nintendo**	3,343	NM	3,343	96	978
17	17	**Alps**[2]	3,278	15	3,278	15	169
18	19	**Nippondenso**[2]	3,254	32	10,721	16	771
19	16	**Omron**	3,250	12	3,293	12	324
20	—	**Toyota**[2]	2,900	5	65,197	15	4,560
21	18	**Kyocera**	2,754	6	3,271	10	394
22	23	**Citizen**[2]	2,600	26	2,902	22	258
23	—	**Fuji Electric**[2]	2,400	12	5,945	9	[illegible]91
24	21	**Casio**[2]	2,378	10	2,378	10	132
25	24	**Minolta**[2,3]	2,300	20	2,600	7	50
26	20	**Seiko**[2,4]	2,300	1	3,035	1	163
27	27	**Matsushita Electric Works**[2]	2,000	23	7,317	16	592
28	25	**Murata**	1,967	12	1,967	12	318
29	28	**Nikon**[2]	1,700	6	2,165	7	248
30	26	**Yokogawa**[2,3]	1,700	5	1,800	5	100
31	—	**Nissan**[2]	1,700	2	42,304	6	893
32	32	**Kenwood**[2]	1,564	19	1,564	NM	56
33	—	**Konica**[2,3]	1,500	4	3,750	4	200
34	29	**Ryosan**[2]	1,497	1	1,497	1	41
35	30	**Japan Radio**[2]	1,466	8	1,466	8	125
36	34	**Yamaha**[2]	1,400	11	3,611	2	120
37	35	**Olympus**	1,400	14	1,758	13	177
38	36	**TEL**[2]	1,349	10	1,349	10	146
39	31	**Fanuc**[2,3]	1,300	5	1,300	5	400
40	—	**Honda**	1,300	-1	30,507	12	1,041
41	37	**Rohm**[2,3]	1,300	8	1,300	8	100
42	38	**Clarion**[2]	1,300	17	1,316	17	54
43	33	**Shimadzu**[2]	1,200	9	1,359	7	82
44	39	**Shin-Etsu Chemical**[2,3]	1,200	13	3,200	6	350
45	40	**Mitsumi**[2]	1,125	13	1,125	13	46
46	41	**Sanshin Electronics**[2]	1,045	7	1,045	7	25
47	46	**TEAC**[2,3]	903	15	903	15	61
48	44	**Kokusai**[2,3]	900	16	900	16	80
49	43	**Ryoyo Electro**[2]	875	2	875	2	42
50	45	**Sanken Electric**[2,3]	875	13	875	13	50

NA = Not available NM = Not meaningful because of change of fiscal year

Yen converted at March 1991 fiscal year-end rate of 141 Yen to $1. Those companies whose fiscal year ended at other times used different rates in their own reporting

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[1] Includes sales of consolidated subsidiary JVC

[2] Consolidation by Japanese accounting rules, which differ slightly from U.S. Securities and Exchange Commission rules

[3] Preliminary estimates before release of final consolidated results

TOP 50 JAPANESE COMPANIES

% change '91/'90	Operating income % sales	Pretax income ($ millions)	% change '91/'90	Net income ($ millions)	% change '91/'90	Net income % sales	Sales per employee	Net income employee	Fiscal year ended
4	7	$4,237	4	$1,836	10	4	$222,000	$8,700	3/91
-8	6	952	-23	386	-36	1	222,300	3,300	3/91
-17	6	1,836	-4	857	-8	3	205,600	5,300	3/91
1	7	3,986	6	1,633	9	3	177,100	5,300	3/91
13	7	1,055	-1	586	-5	3	144,500	4,000	3/91
1	8	1,877	16	829	14	3	231,800	7,300	3/91
-12	10	3,119	-14	1,674	-14	4	164,000[6]	6,200[6]	3/91
37	9	1,096	70	436	60	4	225,400	8,000	12/90
-8	6	1,297	1	566	4	2	242,500	5,800	3/91
-5	5	646	0	333	12	3	301,900	9,200	3/91
23	3	267	21	96	-15	1	192,300	2,600	3/91
-7	3	252	-24	124	4	1	192,500	2,250	11/90
-16	4	160	-24	70	-40	1	234,400	3,500	3/91
NA	12	511	13	243	16	6	277,900	15,900	3/91
22	13	446	22	202	23	5	166,500	8,800	3/91
112	29	1,004	111	489	109	15	1,114,000	162,800	3/91
108	5	143	158	59	1,062	2	136,600	2,400	3/91
13	7	935	16	447	30	4	200,100	8,300	12/90
1	10	319[5]	3	152	3	5	195,600	9,000	3/91
37	7	5,942	34	3,130	27	5	821,200[6]	37,000[6]	6/90
-7	12	463	-9	229	-5	7	112,800	7,900	3/91
52	9	248[5]	48	121	77	4	145,100	6,100	3/91
7	5	251	6	157	59	3	312,300[6]	9,600[6]	3/91
8	6	141	28	65	22	3	317,900	8,700	3/91
-73	2	-15	-112	-15	-155	-1	259,500[6]	-4,300[6]	3/91
NA	5	42	NA	5	-64	0	189,700	300	3/91
18	8	521	15	236	5	3	417,100[6]	14,100[6]	11/90
26	16	366	24	178	32	9	98,400	8,900	3/91
-15	11	199[5]	-11	123	-8	6	252,300[6]	11,800[6]	3/91
19	6	140	12	70	-5	4	201,800[6]	9,600[6]	3/91
-64	2	513	-78	346	-58	1	520,600[6]	9,700[6]	3/91
NM	4	41	NM	16	NM	1	312,800	3,200	3/91
-5	5	90	-30	15	108	0	502,400[6]	11,000[6]	4/91
110	3	57	3	30	30	2	1,115,500[6]	22,300[6]	9/90
5	9	102	3	52	24	4	223,600	7,900	3/91
-11	3	96	-10	54	24	2	221,900[6]	2,300[6]	3/91
50	10	108	-14	52	-12	3	195,300	5,800	3/91
7	11	152	14	79	23	6	374,700	21,900	9/90
-3	31	500	6	250	9	19	641,400[6]	131,000[6]	3/91
-27	3	936	-13	541	-7	2	627,800[6]	10,500[6]	3/91
3	8	80	-15	40	-10	3	446,000[6]	11,900[6]	3/91
167	4	36	143	7	32	0	263,200	1,300	9/90
-18	6	85	-20	43	-17	3	279,700[6]	11,400[6]	3/91
-2	11	340	-1	180	-6	6	538,200[6]	23,800[6]	3/91
130	4	18	NM	11	NM	1	75,000	700	1/91
67	2	24	-5	10	-6	1	1,188,000[6]	12,900[6]	9/90
14	7	54	24	31	11	3	509,900[6]	11,000[6]	3/91
3	9	80	11	50	8	6	463,000[6]	22,600[6]	3/91
-5	5	46	7	22	8	3	1,239,300	31,300	1/91
3	6	40	-8	10	-33	1	436,200[6]	4,300[6]	3/91

[4] Sales of Seiko Corp. (formerly Hattori Seiko) only. Does not include sales of affiliates Seiko Epson and Seiko Instruments, which are separate, privately held corporations. Seiko Epson sold roughly an additional $850 million through its own subsidiary Epson Sales; most of the rest of its approximately $3.3 billion output was sold to Seiko Corp.

[5] Estimate

[6] Figures for parent company only, which tend to be higher than consolidated figures

Source: ELECTRONIC BUSINESS

Catch-22 in the power supply market

Vendors want to standardize architectures, but the very nature of the market could make that all but impossible

By Dave Webb

Throughout the early to mid-1980s, technology in the U.S. merchant market for AC/DC power supplies moved along like a placid, slow-moving river.

Now the water is getting choppy for hundreds of merchant AC/DC power supply vendors. Increasing demand for so-called distributed switching power architectures and for more custom designs is growing in the largest market segments, such as computers and telecommunications. On the bright side, more systems manufacturers are reducing their in-house power supply production and turning to merchant market suppliers.

According to the New York market research firm Frost & Sullivan Inc., power supplies generated $5.6 billion in revenue for U.S. captive and merchant vendors in 1989. Of the two major technology segments—linear power supplies and switching power supplies—the newer switching supplies are now the dominant revenue generator.

Frost & Sullivan predicts that the combined captive and merchant market sales of linear supplies will fall from $2.1 billion in 1989 to $1.9 billion by 1995. Sales of switching supplies should rise from $3.5 billion in 1989 to $6.9 billion by 1995. The firm predicts the captive market will grow with the total market, but captive "sales" won't keep pace with the merchant market, where sales are expected to more than double by 1995.

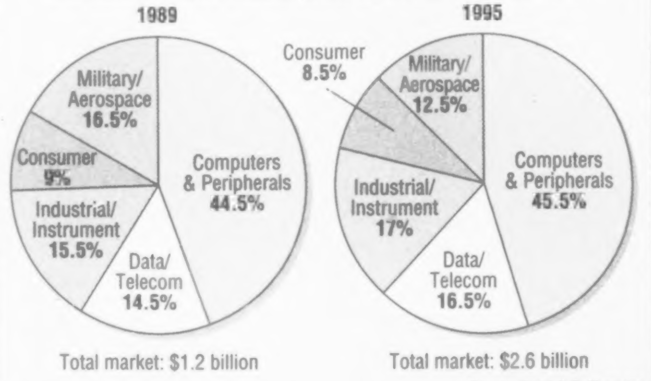
SINCE POWER SUPPLIES tend to be among the last components designed into products such as computers—which now represent the largest single market segment for power supplies—OEM manufacturers have long required some amount of customization to make the devices fit and work within their nearly completed systems. While many of the large OEM producers build their own power supplies, an army of merchant manufacturers (perhaps as many as 500) has sprung up.

Captive vendors are surrendering market share because power supply designs are growing more sophisticated and are "too large a burden" for them to deal with cost-effectively, says Andrew Boyer, Astec America Inc.'s product manager. "Of the very large U.S. and European markets, 60% of them [combined] is captive," says Boyer. "That's beginning to change. Captive vendors are starting to realize that the trade-offs aren't worth it."

This decline in dependence on captive manufacturing is likely to further encourage customization and discourage standardization. To the largest merchant vendors—such as Astec, Computer Products/Power Conversion America, Lambda Electronics Inc., and Vicor Corp.—this is bad news. These companies want less customization and more standardization to achieve the economies of scale associated with volume manufacturing. Because of the higher technological demands on them and the rest of the merchant market, those same companies are better-positioned to meet OEM needs than most of the so-called garage shops

Breaking down the market

U.S. merchant AC/DC switcher power-supply market, by application



Source: Frost & Sullivan Inc.

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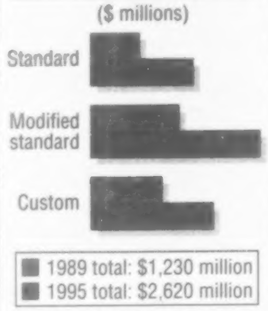
now plying the market.

"This is really a strange market," says Mohan Mankikar, president of Micro-Tech Consultants in Santa Rosa, Calif. "No one [merchant market] vendor dominates the market because there is so little true standardization."

With the large, formerly captive manufacturers turning to outside sources for power supplies, it seems logical that merchant vendors can begin to standardize on the designs required by those volume-order customers. Many think the large pool of small garage-shop vendors would dry up as standardization on volume orders will give winners of those large-volume orders economies of scale to cut pricing to the bone. Small hardware houses can't operate on the low-margin business spawned by such volume pricing.


The merchant switcher market: standard vs. custom

Source: Frost & Sullivan Inc. estimates

Unfortunately for those merchant vendors who would tackle volume markets, standardization isn't happening as quickly as they would like. And one of the biggest reasons OEMs are jettisoning internal power supply manufacturing is that with so many small merchant manufacturers willing to do custom designs, it is more cost-effective to let them do it.

"There's been a slow movement toward standardization, but it's sort of a Catch-22," says Connie Heath, a power component market analyst at the Natick, Mass.-based research firm Venture Development Corp. "[Vendors] want standardization, but the specifications dictated by customers never end up fitting a standard. You're starting out with standard modules which end up being configured on a customer-by-customer basis."

According to Frost & Sullivan, custom and so-called "modified standard" AC/DC switcher power supplies will account for $1.97 billion of the $2.62 billion in revenue it estimated would be generated in 1995.

"There's a wide array of vendors, but there just aren't a whole lot of standards," says Ken Blake, a product marketing manager with Computer Products Inc.'s Power Conversion America division. "Design cycles typically put power supplies at the end, therefore making it necessary to put in custom or 'non-standard' derivations of standard platforms to make them work."

What makes both the Catch-22 standardization and the waning captive market so perilous is the rate of change in technology and innovation. "New technologies are available that are dramatically changing the whole power concept," says a product manager at Vicor Corp.

OEMs are demanding smaller and smaller power units while asking for higher power densities and efficiencies that cut down heat dissipation, says Irving Gutman, executive vice president of Lambda Electronics' North American operations. "The power supply has always lagged [technologically] behind everything," Gutman says.

The market for AC/DC switching power supplies is most commonly divided between computers and computer peripherals, communications, industrial systems and instrumentation, consumer electronics, and military/aerospace segments. The largest segment for U.S. vendors is the midrange power market (150 to 500 watts). Offshore vendors, mostly Asian, have firm control of the low-end, sub-150-watt market, while the market for units of more than 500 watts is dominated by U.S. vendors. ☐

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How to grow your own quality suppliers
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A CAHNERS PUBLICATION

Electronic Business

FOR THE MANAGEMENT TEAM IN ELECTRONICS, COMPUTER, AND SYSTEMS COMPANIES-WORLDWIDE
OCTOBER 7,1991

SPECIAL QUALITY ISSUE

WHAT DRIVES QUALITY AT INTEL

It's NOT cushy MPU profits, but cut-throat commodity pricing

PAGE 28

Closing in on a Baldrige for Intel are (l. to r.) executive VP Craig Barrett, CEO Andrew Grove, and chairman Gordon Moore

Electronic Business

FOR THE MANAGEMENT TEAM IN ELECTRONICS, COMPUTER, AND SYSTEMS COMPANIES—WORLDWIDE

VOLUME 17, NUMBER 20

OCTOBER 7, 1991

Cover photo by Christopher Springmann

By demanding the best, Intel executive VP Craig Barrett, CEO Andrew Grove, and chairman Gordon Moore have helped put Intel in the race for the Baldrige

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Intel 's Embedded Control and Memory Group (ECMG), not its ubiquitous microprocessors, is leading the company's pitch for a Malcolm Baldrige National Quality Award this year. The $1 billion business responsible for flash memory and other subsystems keeps on top of a commodity business with a relentless pursuit of the best from within Intel as well as from its suppliers, while carefully nurturing its customers

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Total quality management is a winning philosophy for Marlow Industries—a Dallas-based company with just 155 employees and $13 million in annual sales

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Following worldwide acclaim for its guided weapons during the Gulf war, TI's Defense Electronics and Systems Group is now gunning for a quality award

SPECIAL QUALITY ISSUE

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INSIDE BUSINESS

Keeping clout in the "Q" word

HAS "QUALITY" become a corporate cliché? Some people think so, and you can't blame them entirely. Even for Baldrige Award winners, the PR bonanza carries its price in endless phone queries and speech requests. For some, controversy over consultant fees has tarnished the image of America's quality movement.

Senior editor Peter Burrows, the chief architect of this third annual ELECTRONIC BUSINESS quality report, wanted to assess the quality movement by putting the question in a different way: Is the quality message reaching its most important targets—the middle managers and factory-floor workers—and is it being shared by electronics companies with their suppliers? As you'll see within these pages, the answer is a qualified "Yes." Quality, once the CEO's pet project, is slowly, in some cases painfully, becoming "business as usual."

As senior editor Teri Sprackland reports, quality may even be the salvation of middle management, where the mores of a corporate culture get passed along from administration to production. Corporate culture, say the executives responding to an exclusive ELECTRONIC BUSINESS survey, is the single biggest obstacle to improved quality.

Elsewhere in this issue, executives share anecdotal evidence of a pleasantly surprising trend: Empowering nonmanagement employees reveals unsuspected managerial talent. David Webb's story about Filenet Corp. and Everest Electronic shows how quality-certification programs have become the cornerstone for a closer kind of relationship between electronics companies and their suppliers.

In evaluating a trend, it always helps to have a big-name player, and in this industry, they don't come any bigger than Intel Corp. Our West Coast managing editor Hugh Willett reports the microprocessor giant is using its hard-won quality lessons as it battles Japanese vendors for preeminence in the emerging market for flash memories.

Let's face it: Even hype has its positive side. As quality management and the Baldrige Award process grow in popularity and visibility, so does the base of available data. As a result, ELECTRONIC BUSINESS is able to improve its look at total quality with a comprehensive guide to quality resources.

—By John Parker

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QUALITY

Past Baldrige applicants begin to see their efforts pay off

IT'S BEEN A tough year for the Malcolm Baldrige National Quality Award. Small companies say applying is too expensive; consultants say it's a corporate beauty contest for attention-seeking CEOs; and everyone else wonders whether an award that can be won by a U.S. car company is even worth winning.

"It's all hype and no substance," charges one ELECTRONIC BUSINESS reader. "If Cadillac can win, then I'm not interested."

Despite the negative hype, however, a government study concludes the Baldrige process *does* pay off.

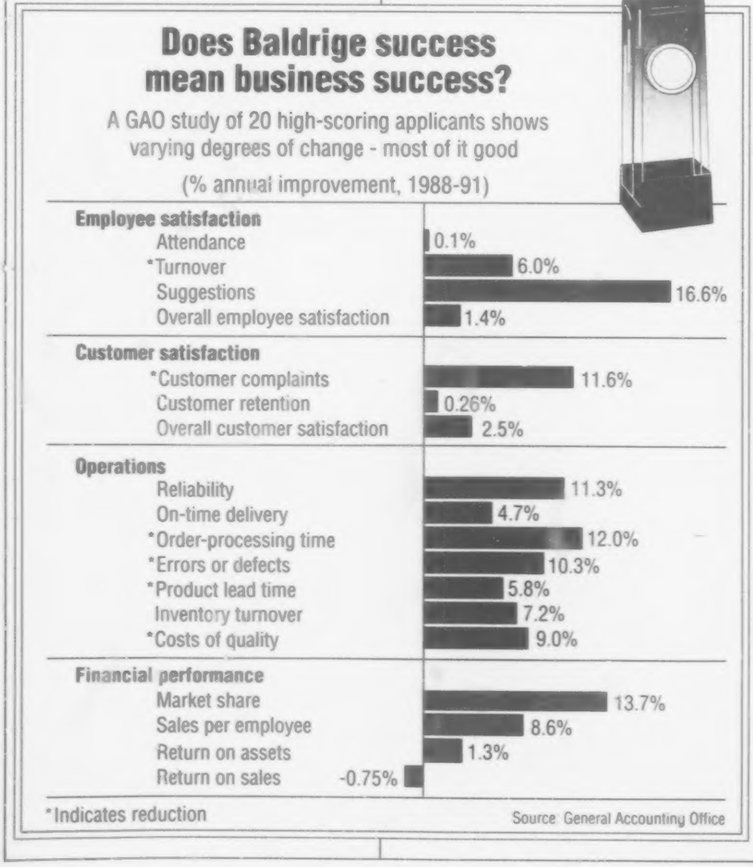
Twenty companies that scored highly on the 1988 and 1989 Baldrige applications have seen related improvement in employee relations, productivity, customer satisfaction, market share, and profitability, according to a recent General Accounting Office (GAO) report.

Operations reaped the most impressive gains. Product reliability, defect rates, order-processing, on-time delivery, lead times, inventory turns, and the cost of quality all improved by between 4% and 12% per year between 1988 and 1991 for those companies. Employee satisfaction grew only 1.4% per year and customer satisfaction only 2.5% per year, but other numbers show that these groups may be more content than they realize. Customer complaints fell by 11.6% per year, and employee suggestions were up 16.6%. None of the indicators investigated showed a negative trend.

Many companies don't even try to quantify the impact of quality programs on financial performance. GAO findings suggest there *is* a definite relationship. The group's market share improved 13.7% per year between 1988 and 1991, and sales per employee rose 8.6%. Smaller gains were made in return on assets.

Regardless of criticism, interest in the Baldrige still is rising. Although only 106 companies applied this year, 49% of 138 companies polled by ELECTRONIC BUSINESS say they will apply in the future. Another 57% are using the Baldrige as an internal assessment tool, and some are even introducing Baldrige-based programs in their overseas operations.

—By Peter Burrows



Does Baldrige success mean business success?

A GAO study of 20 high-scoring applicants shows varying degrees of change - most of it good

(% annual improvement, 1988-91)

*Indicates reduction

Source: General Accounting Office

INVESTMENT

The quality bottom line: Act now, justify later

MILLIONS OF dollars are pumped into quality programs every year, but most electronics executives don't know how that investment affects the bottom line. Most don't even care.

"We are constantly being asked to provide proof of the link between our quality programs and profits," says Craig Walter, director of quality for Hewlett-Packard. Quality is a leading indicator of success, he explains, but profits are a lagging indicator. External factors can also affect profits. "To some extent you just have to take a leap of faith," says Walter.

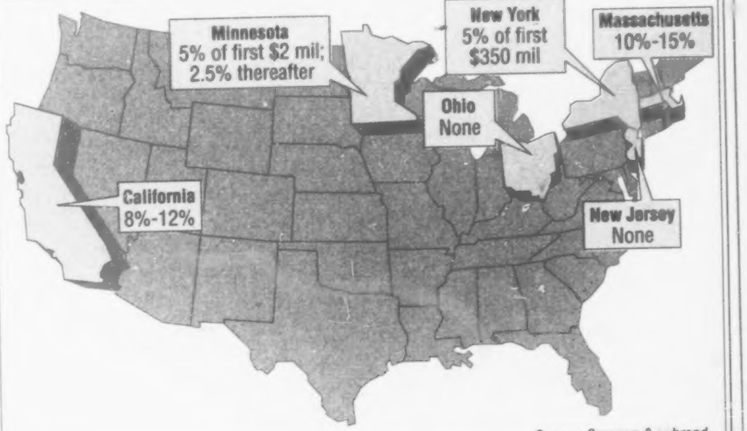
More than two-thirds of 250 midsize manufacturers recently polled by Grant Thornton International, for example, say they do not know how product and process quality affect their profitability. For some, the reason is undoubtedly lazy management not bothering to analyze their businesses. But others say the reason is an enlightened desire to implement quality programs without wasting time and money on non-value-added bean-counting.

Some companies have tried to determine their return from investing in quality. The 77 companies from the Thornton survey that did such a calculation found bottom-line savings of between 9% and 25%. (The industry rule is every $1 saved through quality saves $5 on the bottom line due to faster time to market, increased sales, and lower costs.)

If you are in need of a dollars-and-sense justification for your quality program, help may be on the way. A recent study by KPMG Peat Marwick lays a framework for gauging the internal processes that determine a company's quality: the way it measures customer satisfaction, empowers employees, and learns as an organization, for instance. The American Quality Foundation is developing an econometric model to measure the bottom-line impact of quality.

—By Peter Burrows

How states rate on taxes, R&D credits



Source: Coopers & Lybrand

COMPETITIVENESS

Mass. lures business with aggressive R&D tax credit

THE COMMONWEALTH of Massachusetts, bruised and battered by the recent economic downturn, has adopted what some observers call the nation's most aggressive R&D tax credit policy to attract new, expanding, and relocating businesses.

The new law provides credits of up to 15% for those R&D expenditures that exceed the levels of the previous year and is designed to make Massachusetts "the most attractive state in the country for conducting R&D," says a spokesman for the state's Office of Economic Affairs in Boston. California, another high-tech bastion, offers an R&D tax credit of up to 12%.

The law, retroactive to January 1, makes Massachusetts the 14th state to offer business R&D tax credits. Others include Minnesota, New York, Colorado, and West Virginia. Until now, the Bay State had offered businesses no such incentive.

The new policy offers companies a 10% tax credit on incremental increases in company-conducted R&D expenditures and a 15% credit on incremental increases in new, original research conducted by universities. While the Massachusetts bill is modeled roughly on the federal R&D tax credit law, it differs in at least two important respects: It is permanent, and companies must increase their annual R&D spending in order to realize the benefits.

Proponents of the policy hope that Bay State companies will respond to the law as California businesses did following that state's passage of its R&D tax credit law in 1987. Research in California has risen significantly since that time, notes Teresa Casazza, manager of state government relations for the American Electronics Association in Sacramento, even though overall business has been declining.

Some industry executives, moreover, consider such an incentive an essential weapon in the states' battle for new corporate investment. "It is important that Massachusetts not be competitively disadvantaged with respect to other states," wrote Analog Devices president Ray Stata in a letter supporting passage of the bill.

Still, the issue fueled debate on the short- and long-term impact on state revenue and the overall business climate. Some groups argue there is little evidence that such incentives, in fact, pay off in more jobs or other benefits. The state Department of Revenue, however, maintains that this year's estimated $34 million in lost business taxes will be offset at least in part by higher personal income taxes and other taxes stemming from increased R&D.

—H. Garrett DeYoung

DISK DRIVES

Are there blue skies ahead for disk-drive makers?

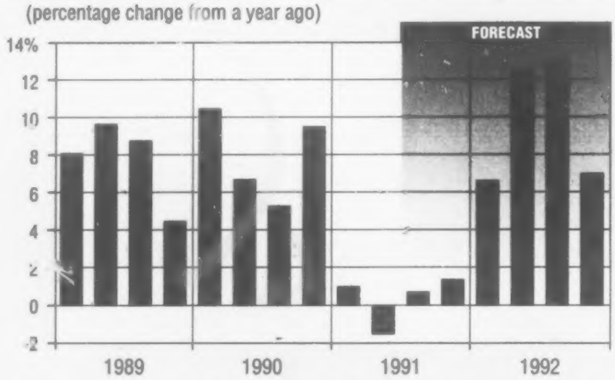
AFTER TAKING IT on the chin for the past year, relief may be in sight for disk-drive manufacturers, as new form factors begin to replace a glut of 3.5-inch drives.

But it's tough to be optimistic given the casualties of the past three

BUSINESS BAROMETER

Slumping revenue growth in '91...

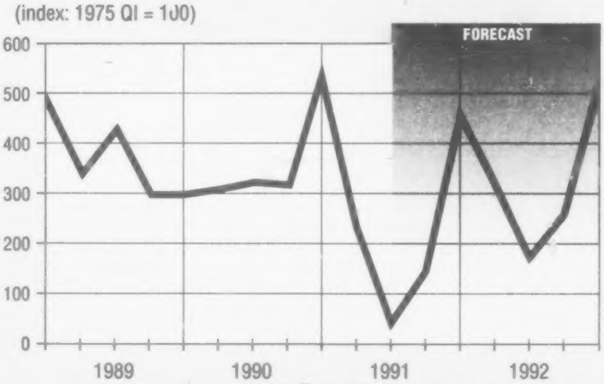
(percentage change from a year ago)



Source: ELECTRONIC BUSINESS; Forecast: Cahners Economics

...and restructuring costs force profits down...

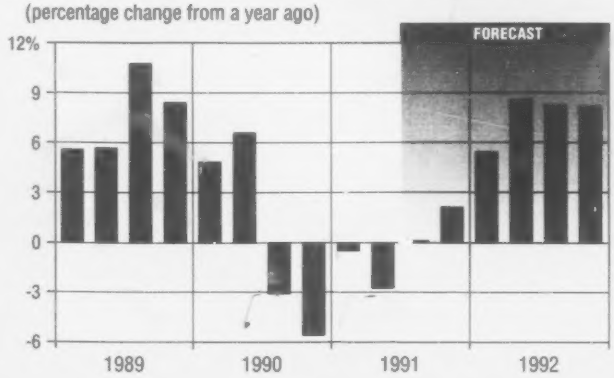
(index: 1975 QI = 100)



Source: ELECTRONIC BUSINESS; Forecast: Cahners Economics

...but rising demand will bring relief in '92

(percentage change from a year ago)



Source: Commerce Department; Forecast: Cahners Economics

Restructuring costs drain profits

THE ELECTRONICS industry is in a state of flux and the cost of those changes has been massive. Several companies that ELECTRONIC BUSINESS tracks quarterly incurred such expensive restructuring charges in the second quarter of this year that the ELECTRONIC BUSINESS profits index dropped to its lowest level since the index began in 1975. The index registered an actual loss in the second quarter of 1991, the first loss ever for the ELECTRONIC BUSINESS profits index.

Digital Equipment Corp. had the largest impact on the profits index during the April-to-June quarter as a result of a $1.1 billion restructuring charge. "The company has opted for more aggressive action in order to prepare for the rapid changes taking place in the industry," says DEC spokesman Bradley Allen. As with other companies, DEC warns of upcoming poor financial performance as restructuring costs continue into 1992.

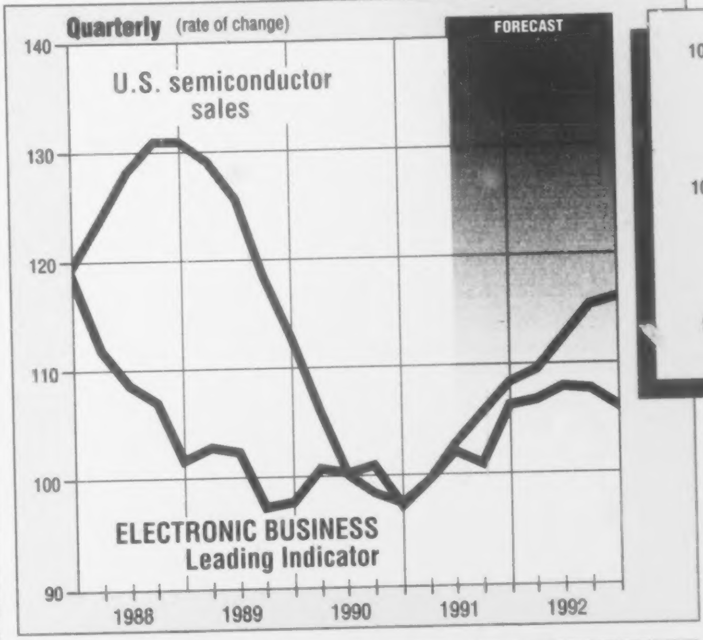
Meanwhile, electronics revenues fared poorly in the second quarter of 1991, falling 1.6% below the same quarter in 1990—the first decline since early 1986. On a brighter note, recent data on electronics orders indicate the industry may have struck bottom and the turning point back upward may now be at hand. Orders for electronics equipment and components are forecast to grow 7.7% next year.

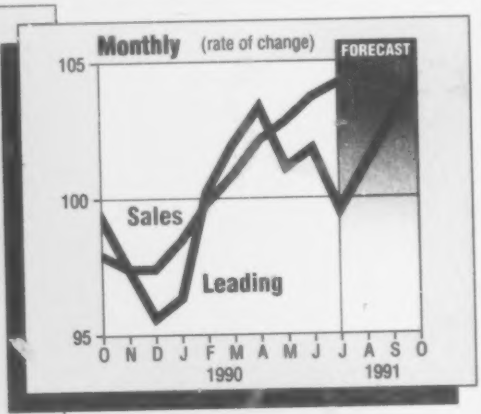
Electronics manufacturers are using the 1991 recession as a chance to reposition themselves for the long term. Managers must now pay closer attention to their product lines, productivity, quality, and customer service in order to reap the rewards of higher profits in the future. Unfortunately, job losses are part of this transition, but the payoff will be a leaner industry waiting to greet rising demand. In 1992 annual revenues in electronics are forecast to rise 9.7%.

—*John Farrell*

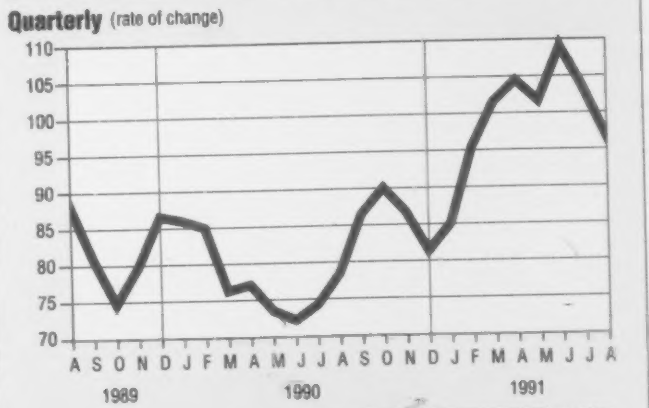
BUSINESS BAROMETER

ELECTRONIC BUSINESS Leading Indicator





Component lead times pull back after initial surge



Source: ELECTRONICS PURCHASING magazine

Leading Indicator stalls again in July

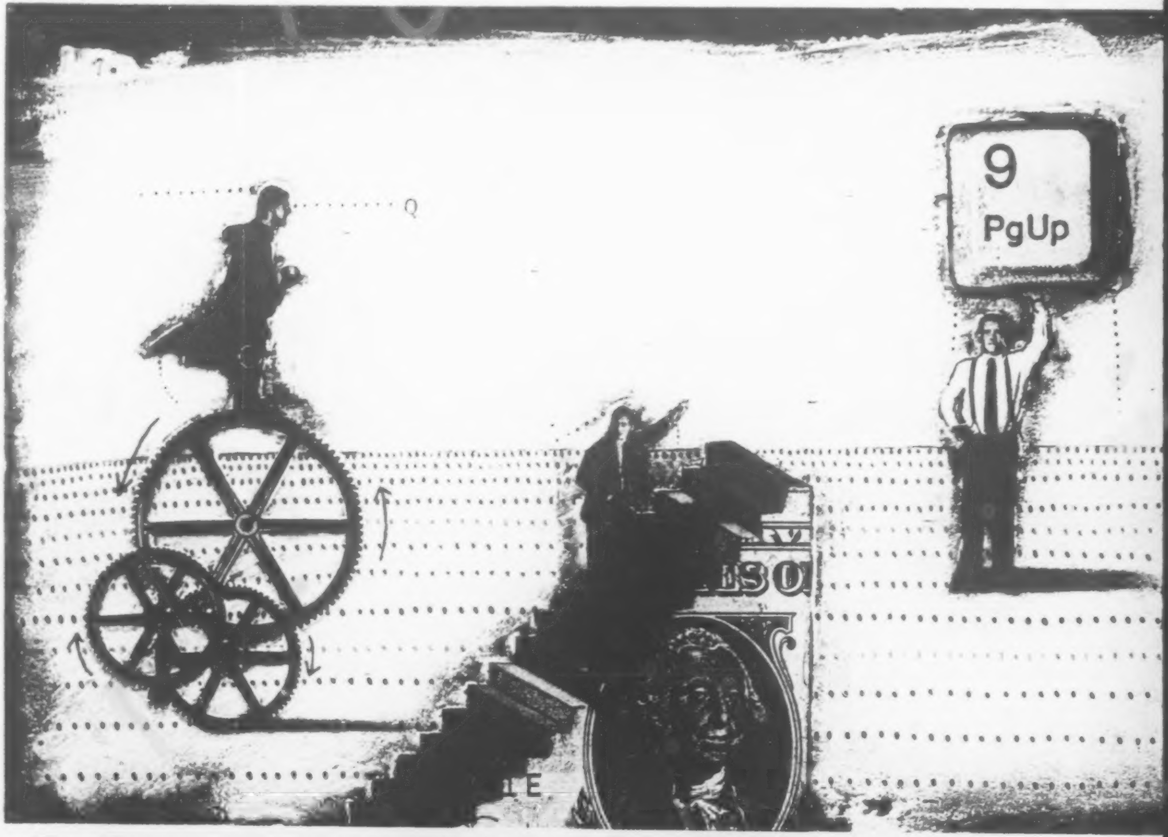
THE ELECTRONIC BUSINESS Leading Indicator (EBLI) fell to 99.5 in July, the third month of sluggish performance and the first month below 100 since January, and the anticipated recovery has been put on hold. Cahners Economics predicts EBLI will expand later this year and next, but the past three months' activity means the rebound will be more spotty than originally projected.

EBLI is a weighted composite of six statistics that lead activity in the electronics industry. To obtain a complimentary background paper, contact Cahners Economics, 275 Washington St., Newton, MA 02158-1630, USA; telephone (617) 630-2119; fax (617) 630-2100.

	Latest month	Previous month	Year ago	1990 average
ELECTRONIC BUSINESS Leading Indicator (rate of change, July)	99.5	101.8	101.3	99.9
U.S. semiconductor bookings ($ millions, 3-month average, July)	$1,237	$1,313	$1,243	$1,254
Weekly hours of semiconductor production workers (monthly average, June)	40.9	41.2	40.5	40.4
Electronic components lead time index (1977 = 100, Aug.)	75.3	73.7	85.9	80.7
S&P's semiconductor stock price index (1970 =10, monthly average, July)	68.3	72.2	78.2	64.6
Change in electronic components inventories ($ millions, SA, June)	-$21	-$28	-$15	$33
Contracts and orders for plant and equipment ($ billions, SA, June)	$31.9	$32.0	$37.5	$38.3

Sources: Semiconductor Industry Association, Bureau of Labor Statistics, *Electronics Purchasing* magazine, Standard & Poor's, Commerce Dept., Bureau of Economic Analysis, Cahners Economics

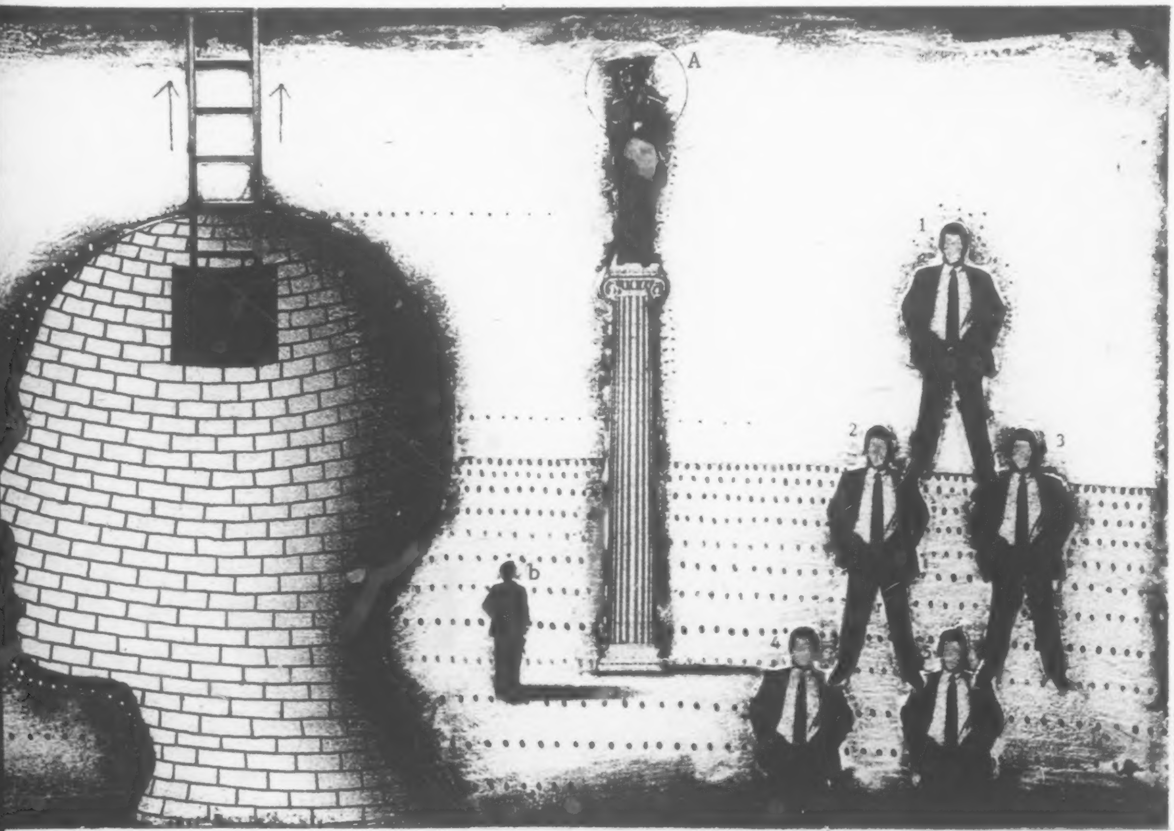
SA = seasonally adjusted; all other data are not seasonally adjusted



CORPORATE CULTURE is the next quality frontier

Sound a bit too warm and fuzzy? Maybe, but that's just what you'll need to hit the big goals of the 1990s

By Peter Burrows



David Lesh

The wake-up call on quality is over. Good intentions, world-class consultants, and well-prepared strategies just aren't enough anymore. What you need now is execution.

For that you need a quality corporate culture, where information flows freely, artificial barriers are systematically dismantled, and employees are enthusiastic and satisfied in their work.

Evidence of the need for a quality culture is everywhere. Many of you are trying to use concurrent engineering to squeeze new products through shrinking market windows—but that works only after the divisional walls have come down. In order to meet your customers' demanding delivery requirements and increase productivity, some of you are moving from volume-based manufacturing plans to flexible manufacturing schemes—but that requires active participation and decision-making from employees, not the passive repetition that comes with economy-of-scale thinking.

To make your journey easier, the following series of stories looks at some recurrent problems electronics companies face as they try to build a quality culture—a Herculean task that requires dramatic change at all levels of an organization. Since quality is not just for manufacturing departments, we also include a function-by-function "quality all-star" team. Whether your interest is in human resources, purchasing, distribution, sales and marketing, or finance, you'll find some solid ideas here:

- **Top executives** cannot just delegate quality but must learn it, live it, and invest in it, no matter what Wall Street says;
- **Engineers** must come down from the ivory towers afforded them in many U.S. companies and learn to work with others in a more integrated, cross-functional way;
- **Middle managers** must conquer very real fears for their job security and accept the role of facilitator for a newly empowered work force;
- **Employees** must overcome their cynicism and fear of added responsibility and use their front-line expertise to improve the way they do their jobs;
- **Suppliers** must meet their customers' rising quality requirements;
- **Distributors**, long a weak link in the quality chain, must mend their ways.

This is the time to take a look at the people side of your quality programs. Competitors from countries that are considered havens for open corporate cultures—Japan, Korea, Switzerland—are pressing ahead themselves. Furthermore, the experience of quality pioneers indicates that there's a larger and faster payback from empowering employees and other people programs than from capital spending initiatives.

Veterans of the quality wars say that technological quick-fixes and rejiggered organizational structures aren't as important as better nitty-gritty people management aimed at soliciting the expertise of each employee. In poll after poll, technologies like robotics and computer-integrated manufacturing get low marks as quality improvement drivers, while relatively simple measures such as "more employee involvement" and "cross-functional teams" rank at the top of CEO priority lists. "What we thought were soft issues are the ones that are turning out to be the key drivers," says Scott Flaig, national director of manufacturing and high technology for Ernst & Young in Cleveland, Ohio. In fact, "employee involvement" was cited as the single best means to improve quality by 582 chief executives polled by ELECTRONIC BUSINESS and the accounting and consulting firm Ernst & Young late last year (see table this page).

If this all sounds warm and fuzzy, don't worry. It should. The vocabulary of culture management includes terms like "psychology" and "group dynamics" rather than clean mathematical metrics like "inventory turns" or "defects per million."

In fact, an increased focus on the people part of the pursuit of excellence is a sign of the maturing of the quality revolution. It has evolved from a top-down dictate of senior management to a more collaborative approach. "It's time to go from the big picture approach to the little picture approach," says Peter Simone, president of fab equipment maker GCA in Andover, Mass. He speaks from painful experience—the fab equipment maker was in a death spiral until its revamped approach to people management improved the quality of the company's products and its fortunes.

The best techniques to improve quality

(Percentage of 582 CEOs rating a method as effective)

Employee involvement	76%
Improved customer communication	33
Quality-related training	26
Quality improvement teams	18
Supplier improvement activities	16
Employee cross-training	13
Statistical application	12
Automation	7

Source: "Electronics '91: Framework for the Future," survey and study by ELECTRONIC BUSINESS and Ernst & Young

An employee empowerment program that brought together different groups within the company reversed GCA's poor quality record, according to Mike Werner, vice president for manufacturing at the company. Part of the empowerment process included breaching the walls between corporate functions. Customer service and manufacturing, for example, successfully implemented a data collection system on equipment in the field. Manufacturing assumed responsibility for installation from the service organization to better understand customer needs. The results were dramatic—the mean-time-between-failure of GCA's best-selling line of steppers went from 43 hours in 1987 to 600 hours today.

OTHER COMPANIES ARE achieving significant quality improvements by empowering employees and then decentralizing decision-making. After ordering HP to improve quality levels by a factor of 10 in the early '80s, CEO John Young now permits each division to determine its own goals in the '90s. Since the company calculates quality in defects per thousand dollars of sales, the business units decided how many dollars to spend on quality improvement versus usability, functionality, or other attributes. HP saved $800 million in warranty costs in the '80s as the company reduced field defects by about 80% and increased manufacturing productivity by 15%.

The decentralized approach to quality management also increases the ability to quickly respond to changes in the market, industry officials note. "The world keeps changing, and the goal is to continue to stay at world-class levels," explains John Scruggs, general manager of HP's Colorado Surface Mount Center in Loveland, Colo.

Early adopters of the quality mantra also have discovered that the success of employee empowerment is based on a more realistic approach by the entire company. As a result, many companies are taking the pap and glitz out of their quality efforts. CEOs who thought that spending a lot of money to fly all their top managers to a resort for a speech by an costly consultant were disappointed that the speaker's expensive words went unheeded. Sequent Computer Systems, Eaton Corp., AVX, and other companies have dismissed outside quality consultants and replaced them with in-house managers who have the personal motivation and leverage with workers to make sure programs stick. "People had come to view quality as what the gurus say it is, and not as a business sense that can be taught and learned," says Curt Reimann, the director for the Baldrige Award program at the Department of Commerce. An AVX official puts it another way: "when an outside person is involved, he's the expert, and everyone else is absolved of responsibility."

Dumping or reducing the use of outside consultants is one of the early signs of a more mature employee-based quality campaign. Another sign is discontinuing the glamorous quality conference at a flashy resort. HP and other firms are canceling off-site training programs in favor of on-site training of employees. Increasingly, these on-site quality sessions occur on the factory floor and focus on actual problems. "Sheep-dip training" doesn't work, explains Joe Nesheim, process improvement manager at HP's Loveland division—you can't teach quality in a remote classroom.

Welcome to the real world of quality.

CEOs talk a good quality game, but. . .

The bottom-line focus often forces quality to take a back seat within the CEO ranks

By Elizabeth B. Baatz

For too long, too many chief executives have preached a good quality sermon but have left implementation of the details to the rest of the corporate flock.

Top execs stand now where Ray Stata, chairman and CEO of Analog Devices Inc. in Norwood, Mass., stood in the early '80s. "With hindsight, the role I played was more of a cheerleader than a participant in the game," says Stata. "That is, my contribution was largely to learn a few buzzwords and slogans, to give speeches, to ask an occasional question; but mostly I delegated the responsibility for change management to others. How I performed my personal work and supervised the work of others did not change very much."

According to the 1991 productivity survey of the American Electronics Association, many senior executives have yet to fully participate in the quality improvement drive. Only 51% of the 311 companies surveyed have a corporate quality council, and only 40% of those councils are chaired by the CEO or president. These figures hardly suggest a stampede for quality from the electronics industry's top execs.

Often executives often aren't even aware of the gap between their quality rhetoric and the reality of their personal performances. Take the case of Roger D. Emerick, chairman and CEO of Fremont, Calif.-based semiconductor equipment maker Lam Research Corp. Says Emerick, "My whole philosophy as a manager from the beginning has been customer responsiveness." But when a customer demanded quality training at Lam eight months ago, Emerick recalls his first response was, "We have a business to run."

Clearly, running the business *is* the main concern of the CEO. As Josh Hammond, president of the American Quality Foundation, says, "Quality is not the top concern of the CEO—profitability is."

The problem for the chief executive and his board is this: The link between a CEO's commitment to quality and the bottom-line payoff is often difficult to discern. Cost savings from reducing product defects and other manufacturing quality programs are obvious. Linking the "unknowables"—like quality training and employee communication videotapes—to increased profits is more murky.

CONTRIBUTING TO THE problem is the fact that growing profits is a short-term goal while improving quality is a long-term objective and a long-term process. Few are willing to agree with Arthur Carr, president and chief executive of data communications vendor Bytex Corp. of Southborough, Mass., that "if your teeth can handle the grinding, then quality is more important than meeting the quarter."

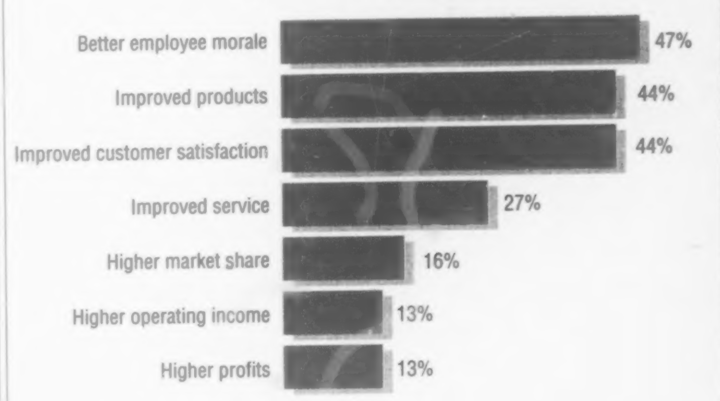
The evidence: few top managers equate improved quality with greater corporate profits. Of the 138 senior executives surveyed by ELECTRONIC BUSINESS last summer, only 13% said higher profits or higher operating income are the most beneficial outcome of their companies' quality programs.

Management consulting firms and others are just now furiously building behavorial models to try to better measure the quality-profit relationship. While these models will provide more data for quality directors to trot into the corner offices, CEOs must nonetheless continue to take a leap of faith in order to become truly quality-driven leaders.

Moreover, electronics industry executives are not alone in their lack of commitment to quality. In a Gal-

How execs rank quality's payoff

(percentage of respondents)



Multiple responses allowed

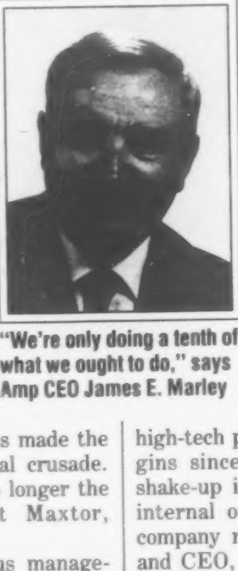
Source: ELECTRONIC BUSINESS

lup survey of 401 U.S. chief executive officers conducted last year, 62% said the lack of managerial attention doesn't affect quality, and 70% said pressure for short-term profits isn't a quality problem.

The Catch-22 is this: Without the whole-hearted participation of the chief executive, the company's quality program is doomed to fail. That statement has become so widely-accepted, it has almost become a mantra for the quality gurus. "The old testament was that quality is a departmental and institutional responsibility," says Robert W. Galvin, chairman of Motorola Inc. "The new truth is radically different. Quality is a personal obligation. If you can't talk with humility about quality daily in the first person, then you have not moved to the level of involvement that is absolutely necessary."

If all the surveys don't convince you there's a problem in the board room, then listen to the quality directors and quality vice presidents who chief executives have been hiring in droves. They say, more often than not, that their number-one goal is simply to persuade their CEOs to raise quality higher on management's list of priorities.

A case in point is Bob Rauch, vice president of quality at Maxtor Corp., who discovered first-hand the difference between a CEO who is committed to quality and one who isn't. His new boss, CEO and president Laurence R. Hootnick, joined the disk drive maker last May. Hootnick has since taken on the mantle of quality and has made the quality-drive his personal crusade. As a result, Rauch is no longer the top-dog of quality at Maxtor, Hootnick is.



"We're only doing a tenth of what we ought to do," says Amp CEO James E. Marley

"It's not that previous management didn't want quality," says Rauch. "It simply wasn't high on their priority list." Now when Rauch calls someone else in the company, he gets an immediate response.

Preoccupied with short-term profit goals and beholden to Wall Street, senior executives often need a crisis to coerce them to jump onto the quality bandwagon. In the past decade, intense competition from Japan provided that crisis. For many U.S. electronics CEOs, the quality game became "do or die," and some succumbed.

One company caught in that struggle is Varian Associates Inc., a diversified manufacturer of semiconductor production equipment, medical instruments, and other high-tech products. Thin profit margins since 1985 helped lead to a shake-up in Varian. As part of the internal overhaul, the $1.3-billion company recruited a new chairman and CEO, J. Tracy O'Rourke, from Rockwell International and Allen-Bradley Co., where he'd built his reputation as a quality-oriented leader.

While the Palo Alto, Calif., company wasn't exactly floundering, its primary market segment—semiconductor manufacturing—was, and Varian needed to be re-invigorated. "A year ago, everything was late, from meetings to deliveries. We'd announce a product one to two years late, not one to two months late," says O'Rourke.

O'Rourke began a total quality blitz throughout the 43-year-old company. Through an intense program of sharing best practices across the company, revolution rallies, and O'Rourke's constant involvement in a new organizational excellence program, Varian's statistics have improved dramatically.

Within a year, one product group saw its cycle time halved from 55 weeks to 22, its cost of rework and scrap fall from 17% to 11%, and its market share rise from 36% to 51%. Even the corporate purchasing department has seen drastic changes; the number of pages in its monthly report was cut from 2,500 to 600. The company now plans to apply for the Baldrige National Quality Award next year.

The world's largest connector maker, Amp Inc. of Harrisburg, Penn., is yet another old-line company that has adapted to the new order. This 50-year-old $3-billion blue-chip company introduced a formal quality program in the early '80s. Amp's training and development spending has risen from around $3 million in 1986 to over $11 million in 1990. The results clearly indicate the effort has been worth undertaking. For example, on-time shipments (zero days late and up to three days early) improved from 67% in 1987 to 91% in 1990.

Still the task of creating a quality-driven corporate culture consumes Amp's president and chief operating officer, James E. Marley. "The approach has been to communicate [with employees] three times as much. Each time I think we're doing it right, but then I realize we're only doing one-tenth of what we need to do," says Marley.

While many CEOS in the old guard stumble on the quality issue, many of them in the newer high-tech companies established a quality-driven corporate culture from the first day of operation. Chief executive Joseph R. (Rod) Canion's commitment to quality since day one at eight-year-old Compaq Computer Corp. in Houston is just one example.

Maintaining the Compaq quality culture is so important to Canion that he updates the corporate history video every year to include recent efforts to improve quality. In the video, Canion and some of its early founders and employees sit around spinning yarns about the early days. That way, stories about the time senior vice president of engineering Jim Harris tossed an early prototype PC down the hallway to test its ruggedness and about the time a junior market researcher overturned Canion's decision to jump into the laptop market are passed on to every new employee and celebrated by every veteran.

Another example of a young company's pursuit of quality from the top is three-year-old, privately held Quality Semiconductor Inc. Having worked at Hewlett-Packard Co. and Integrated Device Technology Inc., QSI founder Chun P. Chui had specific ideas about the kind of corporate culture he wanted to create. He deliberately designed his new headquarters in Santa Clara, Calif., with no corner office; every worker, including Chui, sits in a cubicle. The conference rooms have glass windows facing the corridor, and all 70 employees have been given partial ownership in the company.

What works for a Silicon Valley start-up may not work for an East Coast or Midwest behemoth. Still, past Baldrige Quality Award winners — Xerox, Motorola, and IBM— are proof that large companies with entrenched cultures can become nimble competitors in the quality arena.

IF YOU'RE AN EXECUTIVE who thinks you'll help your company achieve quality improvements by sending your employees back to school without cracking the books yourself, think again. Successful quality-driven leaders emphasize their own training was as important if not more important than the reeducation of the work force. Yet only 57% of chief executives and presidents polled by ELECTRONIC BUSINESS went through some kind of training last year. What about the other 43%? Fact is, a substantial number of electronics executives have yet to go back to class.

Going back to school won't help, however, if top executives don't walk away with a born-again fervor about quality. Preaching quality is definitely part of the chief executive's job, but that's the easy part.

The hard part for electronics executives is the next step: making that humble, very personal commitment to quality. As Stephen M. Berkley, chairman and CEO of disk-drive maker Quantum Corp. in Milpitas, Calif., says, "It is critical to go beyond flag waving. It is important to be a cheerleader at the kickoff, but after that you need to have substance." □

Can the CEO give up veto power?

What would it take you, the CEO, to give up all veto power? That is the question Charlotte Roberts, of Innovation Associates—a consulting company specializing in organizational change in Framingham, Mass.— asks executives all the time. "You can imagine how CEOs react," says Roberts.

When a 62-year-old CEO says, "No way. I can never give up all my veto power. I'm the only one who has the knowledge to make the right decision," Roberts is armed with a stern admonishment. She says, "A 62-year learning cycle is dreadful."

Reducing cycle time is a top objective of the total quality movement and CEOs can be measured on their own cycle time too. For chief executives, the measurement is the time it takes to transfer their knowledge base to others in the organization. "You cannot delegate this to the training and development department," says Roberts. "It's all inside the CEO's head." The major management challenge is to shorten that learning cycle. If managers do not transfer their knowledge and learn how to give up their veto power, the total quality movement will flounder within a company.

"Look at how many electronics companies are still headed by their founders," says Roberts. The problem for founders is they often think they are indispensable to the operation and are the only ones who know the company well enough to make important decisions. But if that is the way your company is being run, chances are true total quality is still missing. □

Power to the workers

Here's how forward thinking companies reap big quality gains by pushing more authority down the corporate ladder

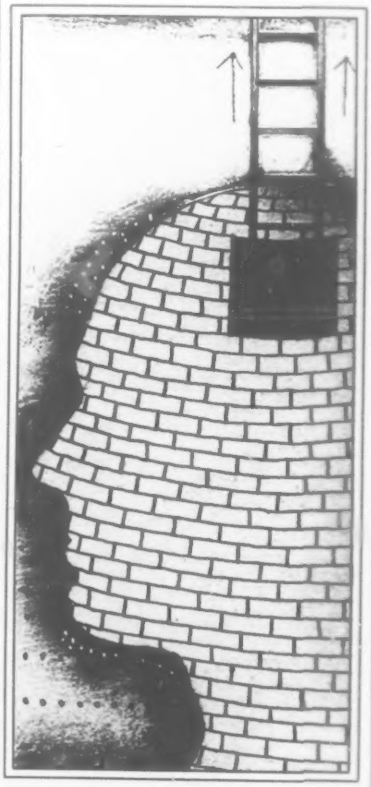
By Peter Burrows

Norm Dulong, a traffic supervisor in the spare parts department of Eaton Corp's semiconductor equipment division, is visibly nervous. For the past 10 months, he and a team of co-workers have reduced past-due sales orders in his department by 292%—down to just one mistake per 13,000 chances—but that was the easy part. Now he has to present the results of the pilot program at the quarterly all-company meeting. The 12-year Eaton veteran has never made a presentation in front of so many people before.

But it goes just fine. When he finishes, the 350 employees erupt in applause. He gets hearty pats on the back from management and even a "Just Do It" Nike t-Shirt for his efforts. It's not hokey, not forced—just an apt response to hard work and results.

Dulong's experience is a living example of empowerment, an overused term for what happens when those on the lower rungs of the organizational chart are permitted to use their nuts-and-bolts expertise to improve the way companies work. The logic seems obvious—those who do the work know best how to improve it—but somehow U.S. executives are having to relearn the lesson. "It's not that I lacked confidence in my people before, but this has really opened my eyes to what people can do," says Peter Younger, Dulong's boss and general manager of the Beverly, Mass.-based plant. "I've known Norm for a long time, but to tell you the truth I didn't know he had it in him."

Executives around the United States are finding out about the Norms who have been languishing unappreciated for years in their cubicles and workcells. With fierce global competition forcing U.S. electronics companies to improve the quality of their products and services, many forward-thinking companies have struggled to find ways to employ all available brainpower to squeeze as much improvement out of their processes as possible. In fact, 76% of 511 CEOs surveyed by ELECTRONIC BUSINESS and Ernst & Young in 1990 named "employee involvement" the single best way to improve product quality.



THE RESULTS OF this trend are hard to quantify, but the rapid proliferation of employee-based quality teams—even at old-guard, tightly managed companies like IBM, Martin Marietta, and Texas Instruments—shows that the impact is explosive. Every employee at IBM's Baldrige-winning division in Rochester, Minn., is involved in at least one quality team each year, says spokesman Dick Ulland. Management at TI's Defense Systems and Electronics Group, one of this year's Baldrige finalists, wants every employee to be in a "self-directed workteam" by the end of 1992.

"We want our employees to just go out and do a lot of the stuff that we used to call 'management'—things like staffing and scheduling," says TI's William "Hank" Hayes, president of DSEG. "It's a new model for how to run a business, and it's totally transforming the way we organize our people and do our jobs."

This revolutionary thinking strikes at many U.S. electronics companies. Rather than view workers as a cost to be trimmed or expanded according to the business cycle, empowerment forces management to treat personnel as a strategic fixed asset worthy of consistent maintenance and investment. "The winners in the next few decades will be the companies with the most empowered work forces," says Michael Dell, CEO and president of Dell Computer Corp. in Austin.

TO KEEP UP in the race, managers must break with the paternalistic business philosophies they were taught in the business schools of the '50s, '60s, and early '70s. Rather than viewing themselves as practitioners of strategies and protectors of their people, they must look to their underlings for guidance—and spend their time creating an environment in which that expertise is shared and implemented. "It isn't enough to just be a good employer anymore," says Joanne McCree, personnel manager at IBM-Rochester. "You have to find ways to help people make as much of themselves as possible."

Fortunately, American workers appear to be waiting and willing for the chance to have a greater impact on the way their work is done. In an ELECTRONIC BUSINESS survey this summer, 138 CEOs named factory workers the group least resistant to quality programs within their companies (besides themselves, that is).

Then why haven't more companies been able to push decision-making down to the lower levels? Unfortunately, many U.S. companies suffer from a credibility gap when it comes to quality. "We've given employees plenty of reasons not to trust us in the past," notes John Gilbertson, a senior vice president at components maker AVX Corp. in Myrtle Beach, S.C. In the early '80s, for example, AVX tried to raise its quality the old-fashioned way—by calling in a guru and hanging flags on the walls. "These guys went around the place like policemen, writing tickets when things went wrong," says Gilbertson. "Looking back, we vastly underestimated our people."

Norm Dulong (seated), a traffic manager at Eaton Corp.'s semiconductor equipment division, headed a team that reduced past-due sales orders in his department to almost zero. Says boss Peter Younger, "Empowerment has really opened my eyes to what people can do. . . . I didn't know he had it in him"

Dave Bradley

After two frustrating years, AVX took a new tack. Employees received extensive job-specific training, were asked to form teams, and were then given lots of latitude to find and solve problems. Poor execution and cynicism kept progress slow at first, says Gilbertson, "but once they saw it wasn't a punitive system, they got excited."

Empowerment programs do not just go on cruise control once management has handed over the keys, however. They require vigilant maintenance. Companies such as Dell, HP, and IBM, use lengthy employee-satisfaction questionnaires to create action plans each year, and specially designated teams implement the plans. National Semiconductor has a formal program to get 50 suggestions per year from every employee, up from the 20 suggestions per employee it receives now.

Enlightened companies are also finding new and diverse ways to reward top-drawer workers. CEO Dell sends a personal note to any employee who is mentioned in a positive light in letters from customers. Many companies hand out checks for $100 or $250 to top employees, often on the spot. Others hand out more lucrative bonuses. IBM-Rochester, for example, gives out $2,000 per team member to the top performing quality team each quarter.

But some of the most effective methods to motivate employees are the ones aimed at more than just the wallet—the employee's sense of responsibility and self-worth. Many executives find that sharing sensitive financial and strategic data with employees at all-company meetings leads to a more interested work force and a rash of cost-cutting suggestions. Installation of closed-circuit TV systems or home delivery of in-house publications make people more informed and aware of the big picture. Friday afternoon keg parties can break down walls and improve morale. Letting production workers instead of salesmen give customer tours gives the worker a chance to get well-deserved credit—and gives the customer a more informed tour.

Such gestures can go a long way. Take Debbie Peterson, a PCB assembler at TI's DSEG plant. When management called a production break last year to announce the empowerment program, her first thought was "How

Empowerment around the world

Here's who top execs share corporate goals and plans with

	U.S.	Japan	Europe
Only upper managers	23.9%	11.3%	45.3%
Only managers	62.5	71.1	43.8
All employees	13.6	17.6	10.9

Source: Boston University School of Management survey

James Cook

Hewlett-Packard equipment operator Jeff Scharpe was recently asked to accompany his boss on a customer visit to help improve understanding of the customer's needs. "That meant a great deal to me," says Scharpe, "especially when he showed me some of our financials on the airplane. He treated me very much as his equal, and I don't get the feeling that employees at most other companies feel that way"

much more money do I get?" That quickly turned to fear. "I asked myself if I had the ability, or the time, to do what they were asking." Now, having added electrical assembly and board testing to her repertoire of skills in an employee-inspired tactic to improve time to market, she says she feels "prouder and smarter. I also work harder to know the product, because I know the finger's going to be pointed at me if I make a mistake."

Under empowerment, though, errors are not occasions for punishment or blame, but for objective analysis and further training. "People should not be afraid to make mistakes," says Phil Gamache, corporate quality assurance manager at Lifeline Systems Inc., a high-flying $32 million manufacturer of personal response systems. "Change is an end in itself, and whether everything works the first time around is entirely irrelevant." To back up its claim, the company has publicly empowered any employee with customer contact to compensate the customer for any product or service not found to be totally satisfying.

Dell Computer, which has grown over 30% in the past calendar year despite the faltering growth of the PC market, provides another glimpse at the empowered company of the future. CEO Dell had never worked for another company nor been to business school when he founded his mail-order business in 1984 at the age of 19. As a result, the company is remarkably free of the complex management structures of most older companies. Manufacturing staff sit in on R&D thinkfests. Technical support people send replacement units to disgruntled customers without a single sign-off from above. "What's the worst thing that can happen?" asks customer service director Laura McDonald. "You waste a little cash and make a customer happy."

"The winners will be those with the most empowered work forces"

Dell Computer CEO Michael Dell

But empowerment is not a blank check for employees; it must be tightly coupled with education and process control systems. Employees must be trained in formal statistical methods and TQM techniques, as well as in the communications and team problem-solving skills necessary to work productively with others. "People must be 'enabled' as well as 'empowered' for this to work," says IBM's McCree.

Most critical of all, employees must be trained to design and work within robust processes so that performance and improvement can be accurately measured. Dell Computer, for example, has a clear process by which technical reps are trained and a process by which they are empowered, not to mention a specific checklist of procedures to go through with the customer before ordering that replacement system. With such processes in place, mistakes become fodder for continued improvement.

What's the down side to this humanistic view of employee relations? For the progressive businessperson, the answer is "none," say the pundits. With market windows shrinking and technology driving ahead, the fatal flaw is not to institutionalize change. Empowerment—not TQM, JIT, or SPC—is the buzzword that puts the "continuous" in continuous improvement. People, not management systems, have the ability to hunt out new areas for improvement.

For many companies, there has been no better time to make empowerment a reality. Most employees have been through some training in the past decade and have the basic tools to succeed, and tough economic times have put workers more in the mood to hold up their end. "This would never have worked 10 years ago," says Jeff Scharpe, an equipment operator with HP. "Most of us know what it's like to work for a unit that goes out of business. With two kids and a wife to support, I'm ready to do all I can to help the company." ☐

The art and science of customer surveys

Focus groups, mail surveys, telephone polls, and spying are some of the techniques the industry uses to gauge buyer satisfaction

By Valerie Rice

Electronics companies are happily infecting themselves with a new affliction these days—"customer mania." It seems almost weekly a computer company or component maker sends a questionnaire to its customers, commissions a third party to interview customers by telephone, or touts its customer-satisfaction rankings in newspaper advertising. Despite the millions of dollars being spent on mail and telephone surveys, focus groups, and other intelligence-gathering techniques, consultants and industry officials say the electronics industry is just beginning to understand how to measure customer satisfaction.

Most industry CEOs say an in-person visit with actual users is the best way to measure customer satisfaction. Moreover, few CEOs consider surveys and market research useful, according to a study released earlier this year of 550 executives by ELECTRONIC BUSINESS and the accounting firm Ernst & Young. It found 67% of the CEOs rate a "press-the-flesh" visit as the most useful method of measuring customer satisfaction, and only 25% regard surveys and market research as useful. "That may indicate either a lack of available systems or a lack of trust in market research methods to capture the voice of the customer," the report notes.

Nevertheless, surveys by leading industry companies are almost a routine event these days. Electronics companies view improved customer satisfaction as an important way to increase revenue and reduce costs. Sound like a contradiction? Not really. "On average, an installed-base sale is five times more profitable than a new-business sale," explains Michael Moon, president of Gistics Inc., a Larkspur, Calif., consulting firm. "In fact, many new-business sales are actually not profitable."

Some companies contend they can correlate their customer satisfaction ratings with financial performance. IBM found each percentage point gain in its customer satisfaction scores meant an additional $250 million in revenue over a five-year period, according to Greg Lea, program director of market driven quality at IBM's minicomputer plant in Rochester, Minn.

A percentage point gain in customer satisfaction meant $250 million in revenue over a five-year period, according to IBM's Greg Lea

In addition, surveys produce important information about competitors and market conditions. Thom Edmonds, quality manager for Hewlett-Packard's worldwide customer support organization, says surveys offer a vital customer-side view of the competition, and Moon adds that companies can be formed from survey information.

A start-up could identify a target company and then buy a list of probable users of that company's product or service, Moon explains. A survey can identify heavy users of the target company's products and determine which elements of the competition's products and services are most valued. Then the new company could reverse engineer that information to see how the target company became successful. "If you interview 100 totally satisfied customers, you will end up with a clear model to apply statistical process control to, and then you can start your business model," he says.

Survey costs range from $5,000 or $10,000 for a simple mail survey of 1,000 customers to seven figures for a worldwide campaign. A focus group session, where a moderator elicits information about a product or company from a dozen or so customers while company officials listen and watch behind two-way mirrors, runs about $3,700, including an honorarium and a modest meal for each participant, and includes a videotaped record. Overall, "a comprehensive, well-designed measurement program" for a hypothetical company with 500 employees and $100 million in revenue would cost between $50,000 and $75,000, estimates Brian Lunde, director of business development with Walker CSM, an Indianapolis consulting firm.

Lunde's proposed program for that hypothetical company includes five steps. The first step is obvious but most difficult: to determine exactly what the company is trying to find out and to write the questionnaire for the interviewers. Contractors handle the second step, the actual distribution of the questionnaires, the telephone polling, or the focus groups. Steps three and four, data collection and analysis, are also provided by consultants and contractors who specialize in customer surveys. Careful planning of the fifth step—the action plan, or how the company will act on the results—is often overlooked. For a company with $100 million in revenue, Lunde says the research program should take about three to four months. Projects for larger companies could take longer than six months and cost considerably more.

Which techniques best measure customer satisfaction?

(% of 550 electronics industry CEOs who rated a technique as useful)

In-person visits to actual user of product	67%
Interaction with upper management of customer	50
Customer service tracking system	27
Periodic surveys/market research	25
Field audits	21
External general market assessments	18

Source: "Electronics 91: Framework for the Future," by ELECTRONIC BUSINESS and Ernst & Young

Hewlett-Packard is a big spender on surveys. An annual survey of 40,000 customers, initiated in 1988 and costing about $700,000 to $900,000, aims to learn more about their level of satisfaction with its service and support department, a $2 billion-plus a year business. Another survey helps the company understand the competition and its customers better, according to quality manager Edmonds.

Lower-cost studies are available through a number of channels. Other third parties and market research firms such as Dataquest in San Jose offer syndicated user studies. J. D. Powers & Associates, a well-known monitor of the automobile industry, recently completed a customer satisfaction survey of PC users and sold the information to the OEMs. Dell Computer Corp. in Houston turned Powers's results into an advertising campaign. Surveys and other research services are also available from trade and general business publishers.

Throwing bushels of money into a survey is not a guarantee that you'll receive valuable insights—careful consideration of the questions is also required. IBM's Lea says there are five key elements to a solid customer survey. The questionnaire or interview should begin with general, administrative-type questions: How hard is it to do business? What is the most irritating thing? Other topics to be included are marketing, product technology, delivery, and service.

Asking the right questions, and understanding the answers, are more challenging than you might think. Customers' perceptions of prompt service vary from industry to industry and from product to product. A one-hour on-site repair service may be considered the minimum for a bank that is nursing sick automated teller machines on holiday weekends, but four-hours may be satisfactory for an accounting department responsible for a monthly general ledger report.

Any industry official who expects to score 100% in a customer satisfaction poll is dreaming—you can't please all of the people all of the time. Highly rated vendors say 5% to 10% of a survey group will never be satisfied, no matter what you do or say. IBM's AS/400 minicomputer line won a Baldrige National Quality Award last year and is considered a tremendous business success for IBM as well, but its overall customer satisfaction rating is only in the "low '90s," percentage-wise, according to quality manager Lea, who hastens to add that the current number is the highest the system has ever received.

Informal customer surveys provide an education as well. They function as an extremely valuable early-warning system to alert managers to their weaknesses in the market. Random telephone spot-checks and other techniques may not offer a comprehensive and statistically significant perspective, but what they lack in quantitative insights they more than compensate for with qualitative lessons. Managers from Dell, HP, Sun Microsystems, and others frequently contact customers by telephone to follow-up on work done by consultants and research firms.

Sun also has some unusual approaches to gathering information about customer satisfaction. Executives take turns in a "listening booth" at trade shows to learn more about customer views of the company and its products, according to Cindy Williams, who is in charge of worldwide customer support marketing programs. Workstation vendors call every new customer to monitor customer sentiment within the first three months of a purchase. Data from these and other efforts are added to the company's historical database, enabling the company to track changes in buyers' needs and perceptions.

Ten years ago focus groups were rarely used by the electronics industry, but no more. These groups are increasingly being used as a tool to improve customer service, in addition to their role in product development and testing. Companies such as Lotus Development Corp. use videotapes of the discussions to provide insights to company employees who are unable to attend. Sun Microsystems instituted a focus group program four years ago, called the "Voice of the Customer," to hear from about 50 corporate workstation buyers periodically on a variety of topics such as support issues. Sun instituted programs to give higher priority to support as a result of the feedback, Williams says.

Customer satisfaction survey checklist

Five key elements are necessary for a solid customer survey, according to the folks at IBM who won a Malcolm Baldrige National Quality Award last year for their AS/400 minicomputer

Element	Typical questions
Administrative	How hard is it to do business with us? What is the most irritating thing?
Marketing	Which channel of distribution do you use? How professional are we?
Product technology	How reliable are our products? What features are important? Is the company delivering the right solution?
Delivery	Was the equipment delivered on time? Was anything missing? Was anything damaged?
Service	How responsive are we to your complaints?

Source: "Electronics 91: Framework for the Future," by ELECTRONIC BUSINESS and Ernst & Young

Tracking incoming complaints and their resolution is another low-cost and statistically questionable method of tracking customer satisfaction. Sun recently began tracking customer complaint letters to determine weaknesses or patterns of satisfaction, as well as to make sure the complaints are answered. The quantitative measure is response time—how fast the customer support staff contacts the complainant and solves the problem.

The plethora of customer surveys and benchmarking by OEMs also provides suppliers with valuable data. National Semiconductor Corp. in Santa Clara, Calif., is a big fan of surveys done by its large customers. They evaluate National based on service, delivery, and performance. National receives scorecards that not only indicate its strengths and weaknesses, but points to those of its competitors as well, says Tim Thorsteinson, director of quality performance. "We focus our activities on the scorecards of the most sophisticated customers," he explains. "That way we can improve performance across the entire customer base."

National's customers were mostly concerned with prompt and consistent deliveries in past surveys, so National recently adopted new systems to ensure on-time arrival of products, according to Thorsteinson. In 1990 its scores on customer service were so weak that the company recently began customer-service training under the tutelage of now-retired president Charlie Sporck.

Unlike National Semiconductor, some electronics companies are simply indifferent to customer satisfaction surveys by third-parties. Dan Hutcheson, president of VLSI Research Inc., a market research firm in San Jose, says that Japanese companies are more interested in customer satisfaction survey data than U.S. companies. "When we release a survey, we get calls from Japanese companies," Hutcheson says. "If they are numbers three, four, or five on the list of the top 10, they want to know how to become number one. They want to respond immediately. Americans are just happy to get on the top 10 list—and they think of it as an advertising opportunity," even if they didn't reach the top of the list.

Smart companies these days are ready, willing, able, and indeed eager to receive customer feedback from any source. Several years ago Hutcheson's survey found one company that had a terrible reputation because part of its machine melted during the manufacturing process. Hutcheson went to the company and alerted top managers to the problem. Incredibly, they claimed ignorance of the product fiasco. The supplier began a crash program to fix the equipment, "mothering" its customers with attention. "By the next survey a year later, the vendor was in the top 10 in customer satisfaction ratings," Hutcheson says.

For a company to be unaware of a major problem until receiving an alert from the outside is symbolic of the electronics industry's embryonic approach to measuring customer satisfaction. In part the industry's ignorance is due to its relative immaturity—it took the automobile industry 80 years and an invasion from overseas vendors before customer service became a major rallying cry. In addition, some electronics industry executives remain unconvinced of the importance of measuring customer satisfaction. "Customer satisfaction just does not compute in the traditional business model," contends consultant Moon. "Executives must conceptually re-think the base assumptions upon which their company is founded." ☐

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A CAHNERS PUBLICATION

Electronic Business®

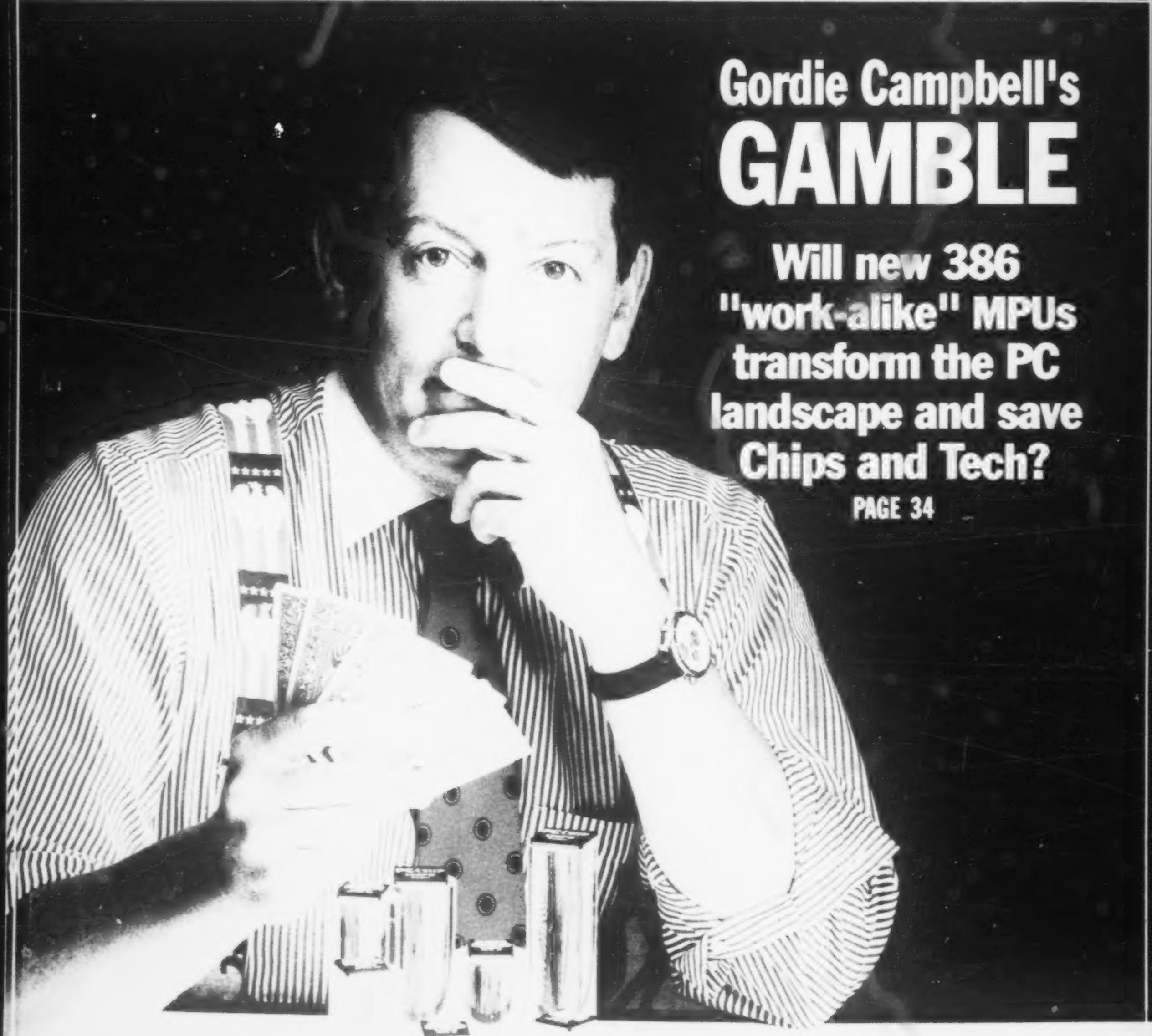
FOR THE MANAGEMENT TEAM IN ELECTRONICS, COMPUTER, AND SYSTEMS COMPANIES–WORLDWIDE

OCTOBER 21, 1991

Gordie Campbell's GAMBLE

Will new 386 "work-alike" MPUs transform the PC landscape and save Chips and Tech?

PAGE 34



Gordon Campbell, president and CEO of Chips and Technologies Inc.

Electronic Business

VOLUME 17, NUMBER 20

FOR THE MANAGEMENT TEAM IN ELECTRONICS, COMPUTER, AND SYSTEMS COMPANIES-WORLDWIDE

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Cover photo by Christopher Springmann

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INSIDE BUSINESS

New roads open to PC marketplace

Senior editor Teri Sprackland

THESE ARE the days of falling empires and unrealized alliances the world over. On this, the 10th anniversary of the birth of the personal computer, industry watchers are witnessing the erosion of an industrial hegemony as important to information technology as the Soviet Union has been to world politics. We're talking about the end of Intel Corp.'s virtual monopoly over the 386 microprocessor.

The recent hard-won legal victory by Advanced Micro Devices, giving it the right to clone the 386, is only the most obvious crack in what could be called the Silicon Curtain. New roads are opening for PC makers, and not a moment too soon. As the PC, itself, coasts to commodity status, manufacturers are desperately looking for ways to restore the kind of profitability they need to innovate, compete, even survive. That's why senior editor Teri Sprackland's exhaustive, in-depth look at the 386 chip market deserves cover-story status in this issue.

Teri takes us beyond the AMD decision to the upcoming generation of "forward-engineered" processors. Freed to some extent from direct legal retaliation, the vendors of these new products are promising added speed and functionality, as well as a faster product-development cycle—which would translate into a radical change in the market for DOS-based systems. Intel executives, and some industry experts, warn of compatibility problems, but Teri finds general agreement that these will be overcome—must be overcome, in fact, if PC makers are to withstand the incursions of RISC-based workstations into the high end of the PC domain. Intel competitors, meanwhile, must balance the high cost of product development against the need to make new products price-competitive. Price cuts remain a powerful weapon in the hands of an industry leader such as Intel. It all adds up to a new competitive arena for manufacturers and a new range of choices for PC users.

Finally, London-based senior editor Barbara Berkman steers readers through the labyrinth of mergers and acquisitions in the European electronics market. U.S. companies are doing their shopping overseas, snapping up European companies at a record clip. Accompanying her report is the exclusive ELECTRONIC BUSINESS listing of top European companies, required reading for acquisition- or investment-minded U.S. execs.

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BPA ABP

tle the portable computer data-storage world with some low-power, lightweight (albeit expensive) 10-and 20-Mbyte flash memory "disk drives."

—By David Webb in San Jose

STANDARDS

User group feud also muddies vendors' waters

EFFORTS BY X/Open to increase its influence within the computer user community could escalate a so-far quiet rivalry with the Corporation for Open Systems (COS). It could also further muddy already murky user-group waters and confuse computer manufacturers seeking direction.

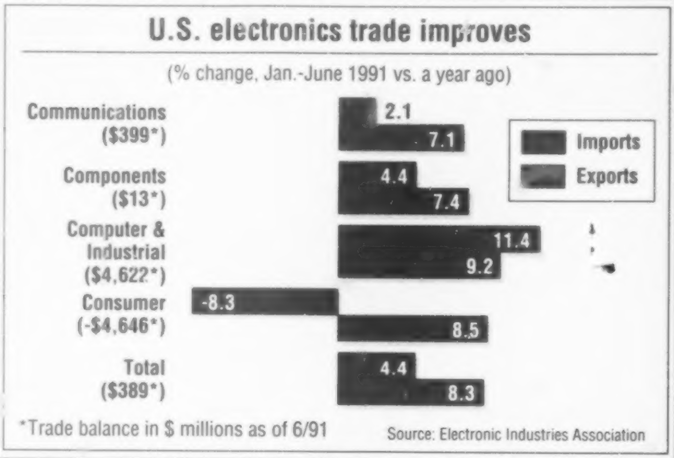
X/Open, a standards-adopting consortium of computer vendors and users, says it wants to give users and software developers a greater say in its direction and has ambitions of becoming an umbrella organization for other user groups. X/Open, in Reading, England, has had some success in establishing an open computing environment based on de facto and international standards, and serving as neutral ground for such bitter rivals as the Open Software Foundation and Unix International.

COS, in McLean, Va., has been pursuing the goal of multivendor interoperability and user support by championing Open Systems Interconnect and comparable standards. In some cases COS and X/Open even have overlapping memberships. COS's claim as the voice of users was strengthened earlier this year when it combined with another group, the User Alliance for Open Systems.

Although X/Open CEO Geoff Morris says his group and COS have discussed closer cooperation, those talks have yet to yield results, says Mike Walter, COS marketing and corporate services vice president. Walter acknowledges some danger of a split in the user community without a common agenda. He plays down the rivalry between the two groups but says the decision by the User Alliance to join COS "speaks volumes" about its standing among users.

—By Rick Whiting

TRADE



*Trade balance in $ millions as of 6/91

Source: Electronic Industries Association

The U.S. electronics industry grew exports nearly twice as fast as imports during the first six months of 1991. As a result, the U.S. enjoyed a $389 million electronics trade surplus, a sharp reversal from the $863 billion deficit seen in the first half of 1990. The forecast: Electronics exports from the U.S. will continue to boost the surplus next year. The dollar is likely to drop slightly because of a soft recovery and lower interest rates in the United States.

—By Elizabeth B. Baatz

STRATEGIES

Cadence/Valid merger will shake up the EDA world

ASSUMING THE INK dries on the pending Cadence Design Systems/Valid Logic merger, how will EDA customers and manufacturers respond to the emerging dominance of larger companies? Should EDA's cash-starved smallfry become nervous about survival? Will EDA users have access to the same range of choices they now have?

One potential problem is adherence to standards. The new Cadence—and perhaps fellow "giant" Mentor Graphics—could decide to renege on commitments to support industry standards to better protect their large market shares. To date, they both continue to preach cooperation as the best means to industry growth.

The new Cadence — the name Valid will no longer be used — will have a 35% share of the $1 billion market for EDA software, up from 23% in 1990, says analyst Gisela Wilson with International Data Corp. By combining Cadence's dominance in chip design with Valid's surging popularity in PCB design, it will replace troubled Mentor as the first option for customers seeking broad commercial EDA solutions, she says.

Some customers plan to delay EDA purchases until Cadence decides what to do with overlapping product lines, but the overall response from users is mostly positive. "We currently do business with too many EDA vendors," says Ben Warren, CAE director at Chips and Technologies Inc. "This could allow us to shorten that list."

The deal is the biggest yet in EDA's ongoing consolidation. Valid, which returned to financial health in 1991 after years of doubt, was the number three player before the merger.

—By Peter Burrows

TELECOMMUNICATIONS

Rural U.S. could be next telecom "Field of Dreams"

IN "FIELD OF DREAMS" Kevin Costner heard voices in his cornfield. Recently, Congress has concluded that *everyone* should be hearing voices in their cornfields—a message that could mean opportunities for telecom equipment makers.

A $385,000 year-long study requested by the Joint Economic Committee concluded that, to compete with city slickers, rural Americans need to beef up their telecommunications strategies. Service industries now account for 57.7% of rural resident employment, and access to advanced telecommunications would provide rural businesses access to major domestic and foreign markets. Before the Bell system break-up, phone companies were required to provide rural areas with equal access to leading-edge telecom technologies, but that is no longer the case.

Among the recommendations:

- Expand the Rural Electrification Administration—a federal loan program—to act as a technology planning or research body as well as provide financial support;
- Implement Electronics Data Interchange technology in rural areas to streamline buying and selling transactions;
- Expand the Rural Area Network, which would electronically link community users in businesses, education, and government;
- Encourage rural businesses to emulate the techniques now used by their urban counterparts—local-, wide- and metropolitan-area networks.

It's unclear how big an opportunity this is for telecommunication service and equipment vendors—the report doesn't quantify the possible business opportunities in dollars. One possible model, the University of Maine/Telecommunications System's new fiber network, was developed with a $4.4 million grant from the Department of Education and a matching grant from the state.

More typical are the rural businesspeople who don't see a need to change. Says one, "I supervise operations, keep the books, even sweep the floor. When would I ever have time to learn about how to use communications strategically?"

—By Quang Bao

MARKET FORECAST

Robotics makers ready themselves for slump

AFTER BUCKING THE recessionary trend last year, the $488 million U.S.-based robotics industry is bracing for a contraction. And it may behoove the components, software, and controller suppliers to the robotics industry to do the same.

New orders dipped 4% in the first half of 1991 compared with 1990 on a unit basis. Although that decline is a far cry from the 25% first-half orders drop that hit during the devastating 1987 industry recession, it does not augur well for the robotics forecast.

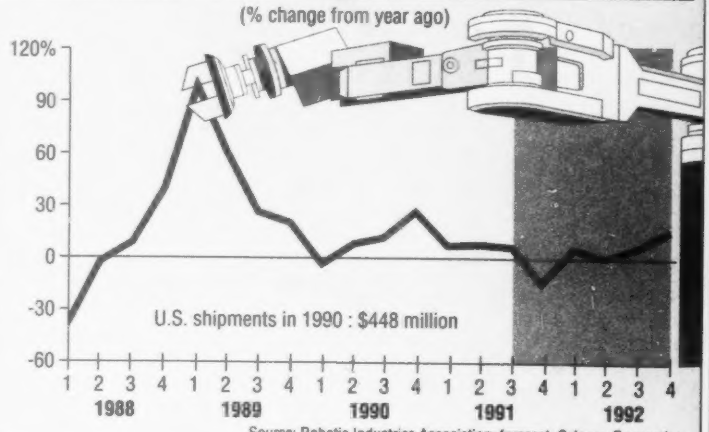
Cahners Economics in Newton, Mass., forecasts a slight drop in sales dollars this year and a 7% rise next year. Bruce A. Potts, vice president and general manager for the industrial division of GMFanuc Robotics, disagrees. Potts expects another peak for robotics sales this year as the automobile industry winds up its capital investment purchases and a decline for robots next year.

According to the Robotics Industry Association in Ann Arbor, Mich., sales dollars rose 7% in the first six months of 1991, but only because of a 12% price increase. Unit shipments of robots actually fell 6%, which is in line with the decline in orders. Pent-up demand for robots has helped U.S. manufacturers force through price increases.

Exports have also been a key to growth in the U.S. robotics industry. International orders accounted for nearly 30% of all orders in the second quarter of 1991. Donald A. Vincent, executive vice president of the Robotics Industry Association, says overseas robotics use is growing faster. He estimates only 41,000 robots are in use at U.S. factories compared with 200,000 in Japan and be-

Growth in robotics shipments staggers in 1991

(% change from year ago)



Source: Robotic Industries Association; forecast: Cahners Economics tween 40,000 to 50,000 in Western Europe. Two of the three top robotics manufacturers are U.S.-based Adept Technology, GMFanuc, followed by Europe's ABB Robotics.

—By Elizabeth B. Baatz

CAPITAL SPENDING

Capital spending plans revised downward for 1992

FINANCIAL OFFICERS at electronics companies are more pessimistic now about capital spending plans than they were three months ago, and makers of high-tech equipment will feel the pinch next year. Capital spending budgets should continue to be revised downward for the next few quarters as profits slide.

Of the 73 chief financial officers surveyed by ELECTRONIC BUSINESS this past July, 31% reported an increase in outlays for capital equipment in the second quarter of 1991 compared with a year earlier. As for the year ahead, only 47% in the finance office expect to beef up capital spending budgets in 1992, compared with 57% who last spring indicated rising budgets for the coming year.

CFOs expect to lower capital spending

(% of respondents)

	1991 Survey quarter	
	QI	QII
Average spending ($ thousands)	$931	$1,149
Expected change in spending in . . .		
. . . 1991 vs. 1990		
More spending	38.6%	34.3%
Less spending	38.6	40.0
About the same	22.8	25.7
. . . 1992 vs. 1991		
More spending	56.8	47.1
Less spending	15.9	18.6
About the same	27.3	34.3
. . . the latest quarter vs. year ago		
More spending	25.6	31.4
Less spending	55.8	44.3
About the same	18.6	24.3
. . . the upcoming quarter vs. year ago		
More spending	29.5	31.4
Less spending	34.1	44.3
About the same	36.4	24.3

Source: ELECTRONIC BUSINESS

The recession caused CFOs to revise their capital spending last year as well. In late 1990, only 25% of financial officers on the ELECTRONIC BUSINESS panel expected to see less spending by the end of the year. When the same group was surveyed again after the year was over, 41% said capital spending had fallen in 1990 below 1989 levels.

Slumping sales continues to be the main culprit for sluggish spending plans, say 43% of the respondents.

The finance execs who work for Japanese subsidiaries in the U.S. report capital spending hasn't slowed at all. "There are no constraints here," says one unknown finance manager, "We are a foreign-owned branch that is going to make a project happen. Cost is no object."

—By Elizabeth B. Baatz

MARKET TRENDS

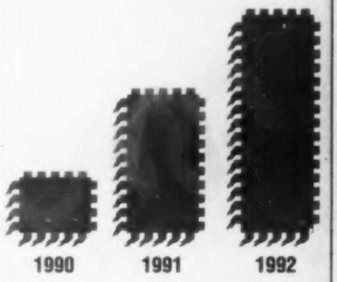
Value added may offsets 4-Mbit DRAM price drop

SOME BATTLE-SCARRED veterans of the commodity memory business are hoping for bigger profits in the 4-Mbit market. They expect to do this by targeting specialized niches to slow the dizzying drop in prices that has plagued every new generation of memory chip as it enters volume production.

Several big-name DRAM producers are focusing on power and packaging features designed to add value in portable computing applications. Hitachi, for one, has introduced low-power versions of previous generation chips and will be formidable competition for the second-tier vendors.

Worldwide 4-Mbit DRAM sales surge

($ billions)



Source: In-Stat Inc.

How successful they'll be isn't yet clear. The 4-Mbit DRAM is expected to triple in sales next year but drop in price by as much as 50% this year as volume comes on line from second-tier vendors such as Hyundai Electronics and Goldstar Electron. Hyundai, for example, expects to double its semiconductor sales to $500 million next year even though prices are forecast to drop from $15 each in September to $10 per part by the end of the year, says Runbir Singh, manager of product planning for Hyundai Electronics America's semiconductor division.

Hyundai plans to diversify out of the commodity DRAM business into specialized speed and power configurations. Portable computer makers are clamoring for chips that can reduce board space and lower power consumption, and they are willing to pay a little extra for the packaging and design features that make such benefits possible, Singh says.

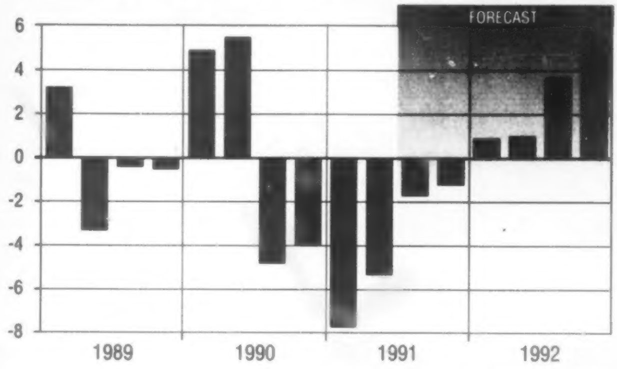
Goldstar's 4-Mbit products feature the lower-power operations and innovative packaging to compete successfully against the first generation of 4-Mbit DRAMs already available from other suppliers. First-generation suppliers are already moving into lower-cost production.

Right now, 4-Mbit DRAM sales are 37% of the total DRAM market but will be 53% by next year, according to market research firm In-Stat Inc. By 1993, the momentum will have moved on to the next density at 16-Mbits, predicts In-Stat.

—By Teri Sprackland in San Jose

Measurement and control sales to expand...

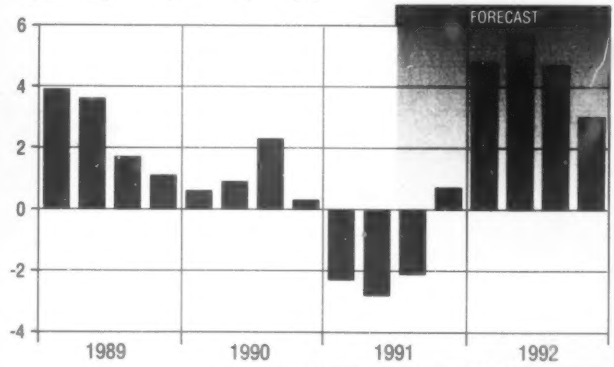
(percentage change from a year ago)



Source: Commerce Dept., forecast: Cahners Economics

...as factory output picks up steam, too...

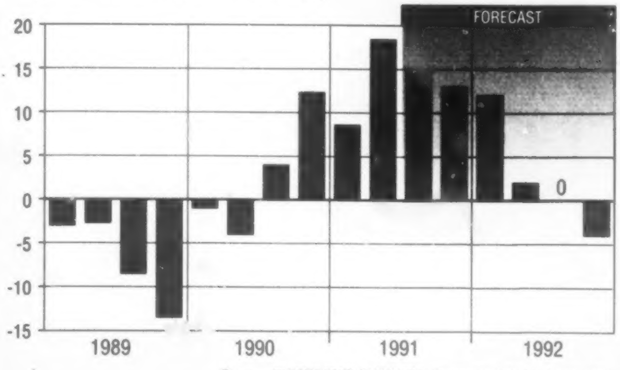
(percentage change from a year ago)



Source: Federal Reserve Board; forecast: Cahners Economics

...and ATE index reveals strength in '91

(percentage change from a year ago)



Source: ELECTRONIC BUSINESS; forecast: Cahners Economics

Measurement market forecast to rise

AN EXPANSION in the nation's economy is due to benefit most industries in the coming year. Manufacturers of measuring and controlling instruments are particularly interested in seeing factory production improve at a rapid pace. Historically, this market closely follows the growth cycle of total industrial production.

In 1988, production in all industries expanded 5.4%—the most recent high for annual growth. During the same year, factory capacity utilization stood at 84.8%, and measuring and controlling instruments also climbed to a peak annual growth rate of 10.7%. By 1990, however, production growth slowed to 1%, factory capacity utilization dropped to 79.4%, and instruments shipments suffered a mere 0.3% rise.

In 1991 measurement and control shipments are likely to fall 4.1% below last year. Relief is in sight, however. Industrial production expanded for four consecutive months after reaching a low point in March 1991, which bodes well for the instruments market. Shipments are forecast to rise 2.9% to $2.84 billion in 1992 and increase again 4.3% to $2.96 billion in 1993.

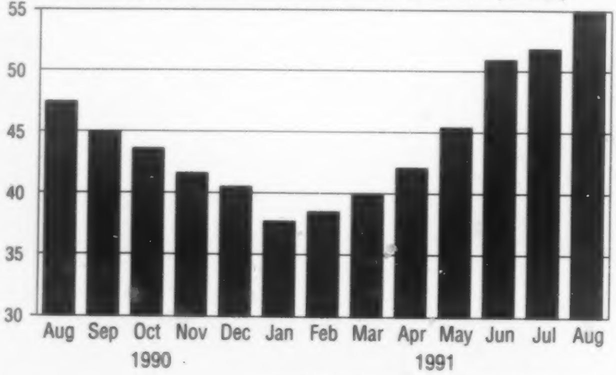
Sales of automatic test equipment are driven by the same factors as the broader category of measurement and control instruments. ELECTRONIC BUSINESS's automatic test equipment (ATE) sales index indicates that shipments in the first half of 1991 jumped 13.5% above the same period a year earlier. ATE sales are expected to climb 13.8% to $2.4 billion by the end of this year.

—John Farrell

For more information on Cahners Economics' forecasting services, call (617) 630-2105; fax (617) 630-2100; or write Cahners Economics, 275 Washington St., Newton, MA, 02158 USA

Buyers reveal the recovery is underway

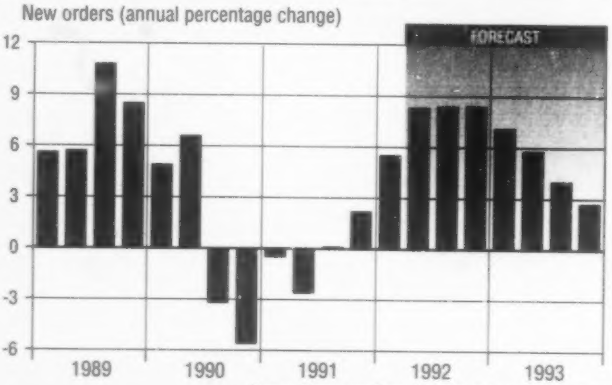
(less than 50% indicates contraction; more than 50%, expansion)



Source: National Association of Purchasing Managers

With demand for electronics expected to rise...

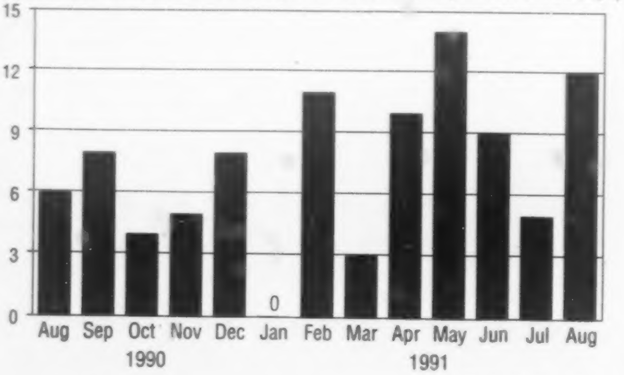
New orders (annual percentage change)



Source: Commerce Dept.; forecast: Cahners Economics

...electronics buyers must begin to re-stock

(percentage of respondents who expect to build inventory in the next 90 days)



Source: *Electronics Purchasing*

Buyer surveys point to recovery ahead

FOR THE PAST few months, talk has centered on whether the economy is actually out of the red. Depending on whom you ask, you might get very different answers. While consumers have remained leery about the economic outlook, purchasing managers have seen positive signs.

The National Association of Purchasing Managers reported the manufacturing economy is, indeed, on its way to recovery. According to their survey of buyers, the Purchasing Managers' Index rose to 54.8% in August, up from 51.8% in July, and its highest level since December 1988. The index registered above 50 for the third month in a row for August, implying that the manufacturing economy has been expanding for three solid months. Prior to June 1991, the index hung below 50 for twelve straight months, suggesting the economy had been in a slump. The strong index value in August came from a surge in new orders, which secures growth in production over the next few months. Interestingly, this past summer's growth in the manufacturing sector took place without the help of increased inventory levels.

More specific to the electronics industry, ELECTRONIC BUSINESS's sister publication, *Electronics Purchasing*, reports in its monthly survey of 500 buyers that electronics companies were beginning to feel more optimistic several months ago. The August survey shows 12% of the respondents plan to build up inventory in the next 90 days, up from only 5% in July and 6% a year ago. Still, chances are the number of buyers planning to increase inventory won't climb to the 1988 levels of 25%. More and more companies are perfecting just-in-time inventory programs. As a result, the likelihood of seeing severe inventory swings as in past years is doubtful.

—*Julie Handelman*

Chips and Tech RAISES the ante in the 386 "work-alike" CHIP WAR

AMD and Chips and Technologies seek to wean PC-makers from Intel's monopoly. The lure, they say, is increased product differentiation

By Teri Sprackland

The introduction of alternative 80386 "work-alike" microprocessors—with most of the new chips claiming better performance and more value-added features than Intel's originals—may finally unchain PC makers from the Intel monopoly. These parts may also provide an alternative to selecting reduced instruction set computer (RISC) architectures.

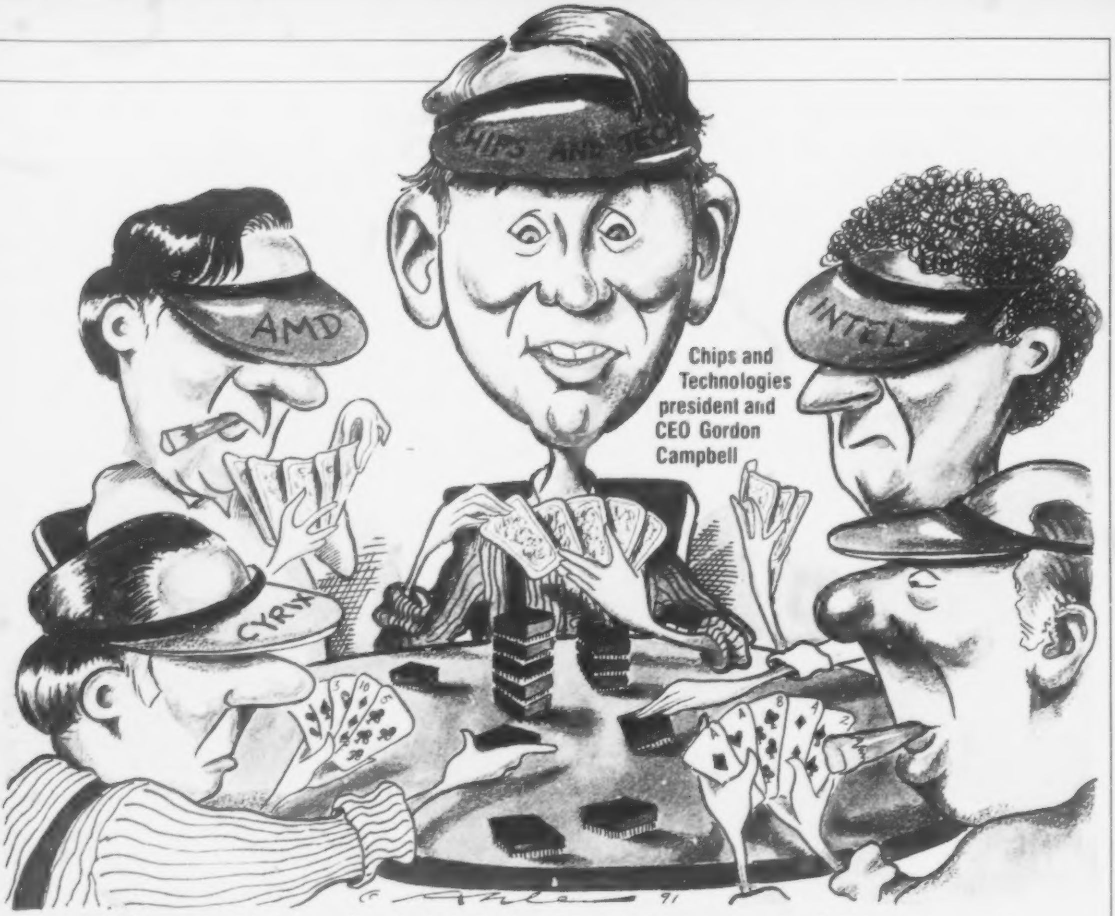
Advanced Micro Devices Inc. (AMD) was the first to jump into the DOS-compatible processor game with its AM386. Now Chips and Technologies Inc. has waded into the fray, and several others—Texas Instruments Inc. (TI) among them—are thought to be close behind. Make no mistake, the flood of 386 work-alikes—or "work-betters" as Chips and Tech president and CEO Gordon Campbell likes to call them—is on the way.

What does all of this mean for the industry? Does it now make sense for PC-makers to tempt the wrath of Intel by using alternative parts? Can gutsy chip makers, some without fab capacity, survive a price war or a battle over intellectual property rights with Intel? Will margins so decline that no one makes money in the DOS-compatible processor business, or will the flood of new products reinvigorate the PC industry by permitting greater product differentiation and lower costs?

Clearly, the PC and iax86 microprocessor business landscape will be forever changed. The last monopolistic leg of the IBM-Microsoft-Intel triumvirate, which invented the PC revolution and rode a monopoly to success, is falling. Whether that's good or bad isn't yet clear.

AMD, in Sunnyvale, Calif., paved the way for the work-alike 386s by pursuing a three-year legal odyssey to validate its right to clone the 386. Earlier this year, AMD introduced clones with higher speeds and lower power consumption than Intel originals, and it earned a number of PC and notebook design wins.

MOST RECENTLY, Chips and Technologies has entered the market with seven iax86-compatible products that it claims are "forward engineered"—that is, they are based on existing standards but are not mask-compatible and do not use the same microcode. The San Jose-based manufacturer, which first stoked the PC clone fires with its chipsets and was later burned by plummeting margins, is offering multiple flavors of the 386. It is hoping to win big sales by giving PC makers a broader choice of options with which to differentiate their product. On paper, that sounds like a strong strategy.



Chips and Technologies president and CEO Gordon Campbell

Dorothy Ahle

Other potential 386 suppliers include Cyrix Corp., Integrated Information Technology Inc. (IIT), and NexGen Microsystems Inc. Even Texas Instruments is said to be close, perhaps partnering with a smaller company. Cyrix and IIT have already successfully introduced value-added Intel-compatible math coprocessors, and both reportedly have "skunk works" processor projects underway.

"The CISC processor market has been fat, dumb, and happy, while RISC has seen performance and price benefits from intense competition. Our intention from the word "go" has been to slow the need to migrate to RISC," says Kevin McDonough vice president of engineering at Cyrix in Richardson, Tex.

PC makers are cheering those words and subsequent part introductions, although some are still doing so quietly. Fear of being caught up in legal battles between Intel and its competitors, fear of becoming the test case for compatibility issues, and just plain fear of Intel have kept the less intrepid PC houses from saying much.

Even many end users are wary of buying a PC without an Intel microprocessor inside. Intel executives made hay over an incident this summer when a customer of Northgate Computer Systems Inc. in Minneapolis, Minn., returned a shipment because the processors used were from AMD, not Intel. Robert Reul, Northgate's vice president of quality systems, says that AMD's parts are completely compatible, "but some customers don't want the extra 8 MHz if it means switching from tried-and-true Intel to a new supplier."

Intel senior vice president David House is among Intel executives ensuring that the world hears about the Northgate returns, which reportedly involved customer concern over how well AMD processors would work within a network of Intel processors.

"It doesn't matter if it's a network problem or a chip problem. There's no such thing as a little incompatible," House says. "It's like being a little pregnant."

PC and chip makers will eventually surmount the compatibility barriers, agree most industry observers. Early adopters are starting out with products based on higher speeds or lower power for specific applications such as notebooks. As the legal issues are clarified and competition increases availability of 386 "work-alikes," OEMs are expected to expand their buying patterns. The new 386s will likely be available with a wide variety of value-added features to help PC makers differentiate their products. That would also provide a weapon to fight off the price/performance attack being mounted by RISC-based workstations.

In the old days, Intel announced the speed upgrades at its leisure—typically not until it had wrung the maximum profit from the earlier generation. On the other hand, RISC microprocessor makers have always competed fiercely to increase performance to cut prices and often introduced faster versions of their chips before systems based on earlier generations have begun shipping.

As the RISC price/performance costs declined, PC makers have wondered if they should stick with the large installed hardware and software base surrounding the DOS-compatible iax86 family or move to RISC.

Intel is trying hard to corral the potential defectors before they start a stampede to RISC. In an unusual change of pace, Intel executives are quite openly discussing their next generation "P5" product—a processor that will offer the performance of the RISC-based workstation engines while retaining full iax86 software compatibility, they claim.

Chip prices expected to fall

	1991	1992*
386 SX	$59	$30
DX	$161-202	$90-110
SL	$144	$100
486 SX	$247	$150
DX	$445-665	$275

*Projected

Source: Needham & Co.

Intel isn't alone in the pursuit of RISC performance and DOS compatibility. NexGen, a San Jose start-up funded by Chips and Tech, plans to release a combined processor chipset with RISC-like features next year that NexGen claims will have twice the performance of the 486 and full compatibility with the DOS and 80x86 standards.

PC makers' big hope, of course, is that the new 386 and 486 processors will expand the

Value-added features separate 386 clones from Intel

COMPETITIVE PRICING IS one of the goals of every chip maker offering clones of Intel's 386, but the real pitch is based on the value-added features that differentiate the work-alike offerings from the original 386.

Advanced Micro Devices Inc. offers 40-MHz speed on its AM386, about a 25% increase over Intel's fastest part. Lower power consumption is another selling point. The fully static core of the part allows the chip to drop to virtually zero power consumption when in a power-down mode. AMD also offers its chip in a low-cost plastic quad flat pack that uses 40% less board space than a conventional and more expensive ceramic package.

Chips and Technologies Inc. has developed a bevy of work-alikes offering more performance, lower power consumption, and greater design flexibility in processors targeted at specific applications.

Most significant of Chips and Tech's achievements is a feature known as SuperState, a user transparent operating system and BIOS that allows the OEM to implement various features such as sleep mode or keyboard scanning in software. The SuperState function is another level of microcode capable of being programmed by the OEM to differentiate its system.

Chips and Tech has also developed a highly integrated "PC on a chip" based on the 8086 processor but offering two to three times the performance of Intel's version. Targeted at notebook, hand-held, and embedded applications, the processor has a fully static core for low power consumption. A graphics controller, memory controller, I/O controller, and other logic are integrated on the same chip.

Though it won't release all the details just yet, NexGen Microsystems Inc. plans to offer twice the performance of a 486 in addition to full DOS compatibility. The company's chipset—actually a six- to eight-chip subsystem—will include a powerful floating-point processor and other peripheral logic functions.

Don't expect Intel to ignore value-added opportunities itself. The company has already introduced its 386SL processor, a low-power static core chip with peripheral [logic on-chip]. Intel has announced plans to proliferate the 386 and 486 architecture horizontally in the future, offering more application-specific versions to meet new value-added opportunities. ☐

total PC market, giving continued life to the clone makers and slow the attack from RISC-based workstations.

AMD's attack on the laptop market is based on AM386 versions that offer low power consumption, small packaging, and increased integration features. The payoff could be enormous. Dataquest Inc., the San Jose-based market research firm, projects a 60% compounded annual growth rate for laptops until 1994.

Worldwide microprocessor shipments

(units in thousands)

	1990	1991	1992	1993	1994
486	226	866	1,076	1,122	1,113
386 DX	3,866	4,198	4,346	4,242	3,885
386 SX	4,828	6,815	7,896	7,752	7,040

Source: In-Stat Inc.

Chips and Tech is going full speed ahead with seven product introductions. Six of those relate directly to the 386 or 387 math coprocessor market and several are rated up to 50% faster than Intel's products. The 0.8 micron CMOS is being manufactured at three undisclosed foundries. Chips and Tech is also targeting specific applications and has hinted that it has in the works a processor designed specifically to speed up Windows 3.0's performance.

ONE DIFFICULT question that potential users of 386 work-alike chips must answer is whether they believe the manufacturers of these chips have the financial wherewithal to succeed. PC-makers don't want to anger Intel by switching to a competing product only to have the new source go broke or be unable to provide performance upgrades.

Chips and Tech spent roughly $50 million developing the new products, according to Campbell. Intel executives say it took $100 million to develop the first 80386.

Intel could launch a preemptive strike by slashing prices, but that would be expensive. "Dropping the price of the 387 math coprocessor took $350 million right out of Intel's bottom line," notes Campbell. "About 50% of its revenue, or 85% of its profit, comes from processor products. We don't think it will dramatically cut prices as it did on the 387.

To some extent, Campbell's comments are clearly self-serving. He seems to be saying to Intel, "Don't shoot! We can both do well enough if we leave each other alone." The fact is, though, the matter may slowly slip beyond either's control.

Plunging prices inevitably follow increasing supplies and suppliers. At Texas Instruments, Jean-Francois Barrati, marketing manager for its PC systems logic group, expects dramatic price erosions and notes that the entry of Cyrix and IIT as alternative math coprocessor suppliers provoked the severe price cut from Intel on the 387 product line.

The price of the 386DX dropped from about $300 each during the spring to $200 during the summer months, TI's Barrati says. "Those guys on Intel allocation were paying a higher price than the spot market—a real inversion. Yet they're afraid to irritate Intel too much because they need access to the 486. The price differential in August between the 486 and the 386 was only about $100," Barrati says.

Currently, it looks as if the winners in the clone processor wars will have the right mix of business acumen and technology sparkle: two parts marketing and management and one part technology, says Erik Jansen, semiconductor analyst with Robertson, Stephens & Co. in San Francisco. "Technically, Chips and Tech may be close, but in marketing and managing, it's way behind. Intel can always play the pricing trump card," Jansen comments.

Indeed, the financial health of Intel's competition has not been robust. While Intel boasts of the $1 billion it spent last year and the billion more it will spend this year on research and development, Chips and Tech posted a $9.6 million loss in the quarter ended June 30. It probably won't turn a profit in '91, agrees Campbell, who says Chips and Tech's move into the processor market is a "bet your company" move.

Cyrix and IIT are small, privately held companies. NexGen is a four-year-old start-up with no product and no cash flow. AMD, a company whose very survival was in doubt last year, is bouncing ahead on the revenue generated by its new 386 product line, but competition will cut into those margins soon, ana-

Mike Webb, AMD's director of marketing for personal computer products

lysts point out.

One key to success will be managing the relationship between suppliers and customers. "The world may not love Intel, but the world doesn't smile too broadly on Chips and Tech, either," Jansen notes, adding that Asian buyers privately comment bitterly on misleading communications about new products from Chips and Tech.

Other potential players have not revealed what value they plan to bring to the processor party. Cyrix's McDonough won't discuss new products beyond math coprocessors, but he advises industry observers to "stay tuned" as development will proceed quickly. "We're not staying in math coprocessors alone," McDonough says.

Integrated Information Technology Inc. in

Legal battles drag on over 386 chips

TREMENDOUS TECHNICAL challenges notwithstanding, the biggest obstacle to those who would try to enter the 386 clone market has been the legal hurdles Intel has erected.

Since its battles against clones from Japan's NEC Corp. in the mid-'80s, the Santa Clara, Calif.-based microprocessor maker has used every legal stratagem at its disposal to protect its monopoly on the 386 and related products.

It appears, however, that the tide of justice is beginning to flow against Intel, despite the fact the company successfully defended its 386 architecture for five years in court. First, a long-awaited arbitration-ruling declared Intel had illegally frustrated Advanced Micro Devices Inc.'s second-sourcing plan. Then a judge ruled the numbers "386" were generic, paving the way for companies such as AMD to use the numbers in their marketing plans.

Still to be resolved is the remedies portion of the arbitration. AMD refers to this section as the sentencing or punishment of Intel and expects to get in excess of $500 million in reparations, as well as clear manufacturing rights to the Intel 386, according to an AMD spokesman. Most industry observers are doubtful AMD will receive a fraction of what it expects to receive in reparations.

In an Intel suit against AMD in the U.S. district court in San Jose, Intel has alleged that AMD does not have the right to use Intel microcode in the math coprocessor products it is selling and the transfer of the microcode under a ten-year-old agreement was for AMD's internal use only.

Chips and Technologies Inc. CEO Gordon Campbell is confident his company can weather any legal storm Intel might precipitate. "AMD exercised a loophole in Intel's intellectual property protection. We don't have any loophole," he says.

The Chips and Tech microcode is "clean room" engineered and completely different from Intel's—even better, he claims. The microcode has been copyrighted and several patents have been filed.

Microprocessor analyst Michael Slater is not so confident. "I think the biggest problem Chips and Technologies will face is the legal challenge from Intel. Even if Intel can't win, it can delay time to market, and that will hurt Chips," he says.

To avoid legal battles with Intel, NexGen has also developed its own microcode and has even taken the step to never hire anyone who has ever worked for Intel. "We're one of the cleanest companies in the world from that point of view. We have a dramatically different architecture. We don't even interview people with Intel experience."

AMD struck a blow in its fight against Intel with a suit filed in late August, alleging that Intel has violated both the Sherman Act and the Clayton Act by engaging in anticompetitive acts to monopolize the market, and AMD is seeking $2 billion in damages. If this case comes to court, AMD will need to present proof of long-standing allegations that Intel has forced customers to buy its other products if they wish to buy its sole-sourced 80386.

"When Intel is put on notice for intimidating customers or charged with anticompetitive practices, it helps erase the fear, uncertainty, and doubt from customer's minds," NexGen CEO S. Atiq Raza says.

"The best thing that could happen would be if a supplier were sued and the issue were quickly resolved. Time is always on the side of the first supplier," InfoCorp senior vice president David Carnevale notes. □

Kevin McDonough, vice president of engineering at Cyrix

Santa Clara, Calif., is another talked-about candidate for building 386 work-alikes that has remained fairly quiet about its plans. The company has already released three grades of math coprocessors. "We're faster, lower power, and cheaper than Intel's math coprocessors," claims Paul Chub, director of marketing in describing IIT's strategy. "Customers deserve a choice."

NexGen CEO S. Atiq Raza acknowledges the development of NexGen's processor has taken more than a year longer than first projected.

"We're feverishly working to produce a product by 1992," says NexGen's Frank Wilde, vice president of sales and marketing.

NexGen's product, when introduced, will be binary-compatible with the iax86 family, with floating-point capability equivalent to a second-generation RISC chip. "We're in the same range as the Mips R4000 or [TI's] Sparc Viking project," Raza claims. "Our competition will be the RISC machines and the Intel 586," he says. Pricing will be "more than competitive."

Surprisingly enough, Sun's recent moves to position itself as a software supplier as well as a workstation maker may help the 386 machines climb the ladder into the workstation world. In September Sun announced that all of its workstation applications—considered the most robust offering of software available for high-end RISC platforms—will be ported to run on 386-based machines. The move gives Sun a bigger market for its software but also legitimizes the usefulness of DOS-compatible PCs in the markets traditionally dominated by workstations.

Chips & Technologies at a glance

Fiscal year ended June 30	1991	1990
Sales (thousands)	$225,088	$293,401
Net income (thousands)	-$9,624	$29,298
Net income/sales	-4.3%	10.0%
Cost of sales/sales	63.3%	54.9%
R&D/sales	23.4%	15.5%
Marketing, G&A/sales	21.7%	15.8%
Number of employees	724	665
Sales per employee	$310,895	$441,205
Net income per employee	$-13,293	$44,057
Capital expenditures/sales	3.8%	4.6%
Current ratio	3.12	2.77
Debt/equity ratio	0.12	0.10
Foreign sales/sales	67.0%	63.0%

Source: Company reports

Across the Pacific, VM Technologies and NEC Corp. may eventually join the 386 or 486 competition, says Michael Slater, editor of *The Microprocessor Report* in Sebastopol, Calif.

SO WHO'S GOING TO USE the new processors? Arche Technologies Inc., a second-tier PC maker based in Fremont, Calif., has put the AMD 80386DX microprocessor into a product aimed at what it calls the PC workstation. The processor's 40-MHz speed has the edge on Intel's product, offering better performance at a significantly lower cost, says Mike Webb, AMD's director of marketing for personal computer products.

Arche's director of marketing, Stephen Doherty, calls his company's relationship with AMD "very close" and questions whether other suppliers will be able offer the same level of reassurance for compatibility anxieties. "They must be absolutely pin- and software-compatible. That's the biggest issue, even bigger than the legal issues," Doherty says.

AST Research Inc. in Irvine, Calif., is using the AMD 386 at the 25-MHz version to power its latest notebook computer. Yet vice president of marketing Mike Morand says Intel has "right of first refusal" as its primary supplier; only if Intel doesn't offer a product variation will other suppliers be considered. However, "AST will always look at other microprocessors if there is a compelling reason—a unique quality that customers want," Morand says.

Most of AMD's design wins so far have been among second- and third-tier computer companies.

Michael Dell, CEO of Dell Computer Corp. in Austin says, "We don't see a massive economic benefit [with the AMD chip]. We're talking about a $3,000 machine that we're basically phasing out. That's a $100 part to begin with, so why save $10 on a $3,000 machine that has declining volume?" ☐

Mergers and acquisitions reshape European electronics

Blitzed by regroupings and the search for critical mass, European computers and telecom become tough sledding for U.S. players

By Barbara N. Berkman

For many of Europe's top 50 electronics companies, 1990 was a year of acquisitions, equity stakes, alliances, and spin-offs of noncore businesses. Concentrated in the computer and telecommunications industries, the changes gave some European companies more market share, access to new markets, and stronger financial positions.

In fact, mergers and acquisitions (M&As) in the electronics sector, both the number of deals and their value, outpaced such activity in any other European industrial sector, according to New York-based Translink's *European Deal Review*. While M&As in other industries were interrupted by the recession and the war in the Persian Gulf, restructuring continued unchecked in electronics, especially in telecommunications and computers.

A quick look at Europe's top 50 illustrates the extent of the changes: Top-ranked Siemens AG boosted its product range by buying Nixdorf Computers AG, for example, while number-two Philips regained some financial stability by ditching most of its computer operations. In the number-three spot, Alcatel-Alsthom now appears where Alcatel NV once stood. The new name reflects a web of international strategic alliances in telecommunications, energy, and transportation.

U.S. companies helped fuel the metamorphosis. Of the 163 cross-border acquisitions last year, U.S. companies accounted for 23, making them the most active non-European acquirers of European electronics, electrical, and computer companies, according to Translink.

The rest of the deals revealed some interesting statistics among the European deal-workers:

- With 35 acquisitions, France's aggressive state-controlled companies topped Translink's list;
- Britain came in just behind France with 28 acquisitions. The country also managed to retain the number-two spot (behind Germany) as the most popular target for European M&A activity, suggesting that Britain remains a popular stepping-stone for companies into the rest of Europe;
- Japanese companies made only nine acquisitions in 1990 but suffered a disproportionate political backlash. The reason: Many of their European targets—including International Computers Ltd. (ICL)—were seen as sacred cows;
- Although Germany was a hot-bed of M&A activity, German companies made relatively few deals, probably because of the distractions and costs associated with unification.

European computer companies accounted for a big percentage of the

continued

Who is buying in Europe

Cross-border mergers and acquisitions of electronics companies

	1989		1990		1990 vs. 1989
	Number of deals	**$ millions**	**Number of deals**	**$ millions**	**% change**
Country buying					
France	14	$ 324	35	$1,869	477%
United States	23	1,271	24	1,616	27
Japan	5	28	9	1,530	446
United Kingdom	26	223	28	512	130
Netherlands	3	187	16	200	7
Sweden	10	22	14	138	527
Germany	7	2,057	6	69	-97
Switzerland	13	85	18	55	-35

Currency conversion factor: U.S. $1 = 1.28 ECUs

Source: Translink

Motorola and PacTel exit European partnerships

TWO YEARS AGO, Motorola and Pacific Telesis (PacTel) each invested heavily in one of the three British consortia formed to create a new mobile-telephone market for Britain. The lure: Analysts estimated that each of three new personal communication networks (PCNs) could be worth up to $3.5 billion. Yet shortly after joining consortia that bid for PCN licenses, both Motorola and PacTel cashed in their chips before losses mounted. What went wrong?

In fact, several things went wrong—U.S. players were overly enthusiastic, analysts were shaky about predicting consumer needs, and the British government allegedly sent out mixed signals. Most important, the tale highlights the perils of leaping too quickly into a European electronics marketplace transformed by the recent blitz of mergers, acquisitions, alliances, and deregulation.

Some blame the British regulatory authorities for the PCN fiasco. Britain had two analog cellular phone networks that were used mostly for business, but the three PCN networks were to offer cellular for the masses. The government decided the U.K. market could support all five networks. "The [British] Department of Trade and Industry must take a certain element of blame," says Nigel Cawthorne, editor of *The European Mobile Communications Report*. "Their ideas were a little half-baked."

Perhaps even a little sinister, according to Hugh Small, European director of Arthur D. Little in London, who suggests the government really wanted to promote competition against former monopoly holder British Telecommunications plc. "U.S. companies were almost used by the British government," he says.

Nonetheless, U.S. companies rushed to grab the three licenses by partnering with local Europeans. By and large, the relationships were "marriages of convenience," says Small. "People were rushing to find partners and didn't care who they were, as long as they had the right political mix." Within six weeks of the formation of the consortia, Motorola had joined with Cable & Wireless (C&W), and Telefonica and PacTel had linked up with British Aerospace, Matra, and Millicom. U.S. West, meanwhile, partnered with STC and Thorn EMI.

The U.S. investors soon realized that PCN was not such a novelty after all. "It's just digital cellular," says Lee Cox, CEO of PacTel. Because the markets overlapped, he says, "all five networks would be selling basically the same product."

IN MAY 1991, PacTel sold its 25.3% stake in its PCN network to its co-investor British Aerospace. (PacTel remains active in building Europe's digital cellular market in Germany and Portugal.) In turn, British Aerospace sold its own stake to Hutchison Telecommunications Ltd.

Two months later, Motorola sold its 40% equity interest in Mercury Personal Communications Ltd. to C&W, Mercury's parent company. Mercury then merged operations—a move expected to save each consortium some $680 million—with Unitel, the PCN network owned by U.S. West, STC (now Northern Telecom), and Thorn EMI.

U.S. West is the only U.S. company that didn't desert the PCN market as an operator. Motorola remains an equipment supplier to C&W and a heavy investor in the new European digital cellular standard known as GSM. PCN conforms to the GSM standard but will operate at a higher frequency than the digital mobile phone networks now being built in Europe.

The Motorola-PacTel incident highlights the frailties of market research. It also points out the limitations that non-Europeans face when relying on local partners for guidance in a risky new market.

Earlier last year, Motorola had a much rosier view of the PCN market. In addition to its PCN license, Motorola supplied equipment to the analog cellular networks and invested in a new British factory to build digital cellular equipment. Motorola believed that the more subscribers there were—whether on PCNs or on mobile networks—the better for its equipment sales.

EVEN THOUGH it has sold its interest in the network, Motorola sources insist that the company hasn't lost interest in PCN opportunities. "Both C&W and Motorola agree the long-term future for PCN is bright," says Jerrold Adams, Motorola's director of PCN operations. Where Motorola and C&W differed was in the "short-term perceptions on the operational objectives," he says without elaboration (perhaps because Motorola remains an equipment supplier to C&W). He adds that Motorola has "not soured on partnerships, nor on the PCN market."

Still, the shakeout does call into question the inability of U.S. companies to correctly evaluate the market for new digital technology. One possible reason is that PCN is a mass-market item; unlike current mobile phones, PCN phones could be multicolored and chock-full of feature options. "Marketing to consumers is totally different [from current strategies]," says Don Burns, general manager of the European Cellular Subscriber Division.

The clincher for the U.S. companies was the realization, however late in the game, that they had invested too much in a developing market that already had too many competitors. "PCN is still a good business," says PacTel's Cox, "but not with five operators." □

continued

M&A blitz: The U.K.'s Apricot Computers Ltd. sold out to Mitsubishi Electric Co., while Fujitsu picked up ICL. ICL, in turn, bought Finland's Nokia Data, and France's Groupe Bull snapped up the microcomputer unit of the United States' Zenith Electronics Corp. In Britain alone, computer and services mergers jumped 11% in 1990 to 138 deals, up from 124 in 1989, according to market researchers Broadview Associates in London.

The regroupings were driven by several factors, including the eagerness of non-European companies to gain a toehold in Europe and the fact that hardware manufacturers looking to increase European revenue from systems integration and software. Many of the deals, however, were triggered by weaker computer makers' lack of critical mass and inability to continue alone in the battered computer market. By providing financial stability and wider market reach, the deal-making ostensibly strengthened such European companies as ICL and Nixdorf.

Still, deal makers seemed optimistic. The cardinal rule of mergers, for example, holds that the best corporate marriages are between healthy companies. That didn't stop Digital Equipment Corp. (DEC) from snapping up Philips's bleeding computer unit, however, or Siemens from grabbing the ailing Nixdorf. A year after the Nixdorf purchase, Siemens Nixdorf Informationsysteme announced a loss of almost $600 million due to of restructuring costs. SNI had hoped to be profitable in 1991.

Americans don't seem to understand why so many European computer makers go under

Nor is everyone sold on Digital Equipment's European strategy. True, DEC obtained market share by buying a sick company for only one-third of its sales, but given DEC's own weak position—the company eliminated some 12,000 jobs and took a $1.1 billion charge in fiscal 1991—some analysts admit to being confused. The Philips unit had "a reasonably sized installed base that wasn't going to grow," says CS First Boston analyst Kevin Brau in London. Adds Roger Cooper, vice president and general manager of Sequent Europe, "I don't think Americans understand the reasons behind the failures of European computer companies." One of those reasons, he says: the costly labor and social benefits that are shouldered by European companies.

On another front, deregulation and new technologies signaled the rebirth of Europe's telecommunications market last year. As in computers, the industry responded with a

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frenzy of M&A deal-making designed to increase the players' market shares, create critical mass, and forge new relationships across old political boundaries.

One example was Northern Telecom's purchase of STC plc, the British equipment maker, as an entry into the British equipment market and as a European base to counterattack archrival AT&T Corp.'s own European strategy. With GEC plc, telecom heavyweight Siemens also picked up British equipment maker GPT plc. For now, the purchase gives Siemens a shot as a supplier to British Telecommunications plc; long-term, Siemens probably will sell out to GEC.

AT&T, itself, made inroads into Europe by scooping up Istel plc, Britain's big EDI and services company, which AT&T hopes will boost both European revenue from electronic messaging and British sales of AT&T computers. AT&T also bought 20% of Italtel SpA in 1989 as a springboard into the European telecom equipment market.

Another deal—last October's cross-shareholding agreement between Fiat subsidiary Telettra and Alcatel-Alsthom—delivered both geographic benefits and the potential for product integration in telecommunications, as well as in artificial intelligence, robotics, avionics, and components. The transaction is important in Europe because it gives Telettra the financial muscle to move outside its home turf of Italy and Spain. It also gives Alcatel a bigger stake in the French transmission market and a stronger position in the world cable transmission market dominated by AT&T, Siemens, and Fujitsu.

Some of the Euorpean deals, such as the Siemens-Nixdorf merger, seemed positively bizarre by most standards

Telettra had been on the block for years. The leading suitor was the Italian government, which wanted to merge the equipment maker into its state telecommunications hoidings. The deal was a blow to non-European equipment makers; if Telettra had become government-owned, for example, AT&T would have had stronger links to the state telecom market through its 20% stake in Italtel. In the end, Italian infighting blocked the deal and stymied other suitors, including Siemens, NEC, Fujitsu, and AT&T.

The restructuring in European telecom has taught U.S. companies to move cautiously into European markets. Many companies have already learned that, for all its opportunities, the restructuring of Europe's top electronics companies can bring heartache as well. ☐

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Sales were up, but profits nosedived

Productivity among the European top 50 jumped 22% last year. Alas, the rest of the numbers weren't nearly as cheery

By Linda Stallmann

Despite higher sales, 1990 was a disappointing year for Europe's top 50 electronics companies. Electronics sales rose 24% to $179 billion, from $144 billion the year before. Profits fell 26%, however, to just over $13 billion due to exchange-rate movement and restructuring and employee-reduction charges. In 1990 the top 50's profit margin came in at just 2.4%—a big drop from the 4.5% margin of the year before. By comparison, the 50 top U.S. electronics companies posted a 4.9% margin last year.

As a group, the European companies did manage to improve their productivity as measured by sales per employee. In 1990 the average productivity reached $130,600, a 22% increase over last year's $107,500 rate, but still well below the average $154,600 logged by the top 50 U.S. companies. This measure should rise even further during the next year as many European companies, like their U.S. counterparts, cut their work forces to become more competitive.

Another way to strengthen competitiveness is through capital spending and R&D investment. The European top 50 increased R&D expenditures by 23% to $28 billion. As a percentage of total sales, however, that was only 5.1% in 1990, down from 5.7% the year before. Capital expenditures fell, too, from 7.9% of sales in 1989 to 7.0% last year. The top 50 U.S. companies invested 5.5% of their sales in R&D and 7.6% in new plant and equipment.

SEVERAL OF Europe's top electronics companies were adversely affected by sluggish economic conditions in key markets, exchange-rate fluctuation, and restructuring. One of the biggest changes was at the very top of the list, with Siemens replacing Philips as the top European electronics company in terms of electronics revenue. Siemens's electronics sales rose 12% to more than $25 billion, while Philips's sales tumbled 3% to $23.8 billion. For Philips, changes in top management and radical reorganization resulted in a loss of more than $2.4 billion. "The realization that Philips was vulnerable and might not last forever came as a great shock both inside and outside the company," said Philips president J. D. Timmer.

Other European companies hit by sliding sales and earnings include Ferranti International, where sales dropped by 12% and profits by a whopping 69%. At STC, which has since been acquired by Northern Telecom, revenue dropped 12% to $4.1 billion due to lower turnover in the company's information and communications systems operations.

Meanwhile, GEC's acquisitions of Plessey and Ferranti's businesses increased its electronics sales by 24%, to $10.4 billion, even though the recession trimmed earnings from the previous year. The biggest rise in electronics sales was the 302% gain by Leica, which was formed by the merger of Wild Leitz Holding AG and The Cambridge Instrument Co. Their integration created a $993 million company. ☐

European vs. U.S. electronics companies

	Europe's top 50		U.S.'s top 50	
	1989	1990	1989	1990
Electronics sales ($ billions)	$144.2	$178.9	$272.6	$292.2
Total sales ($ billions)	$401.5	$553.2	$610.9	$647.7
Net income ($ billions)	$18.2	$13.5	$31.4	$31.7
Net income/sales	4.5%	2.4%	5.1%	4.9%
R&D/sales	5.7%	5.1%	5.7%	5.5%
Capital expenditures/sales	7.9%	7.0%	8.1%	7.6%
Non-European sales/sales*	NA	25.6%	34.9%	37.1%
Sales/employee	$107.465	$130.604	$140.245	$154.598

*Sales outside of Europe for top 50 European and sales outside U.S. for top 50 U.S. companies

Source: ELECTRONIC BUSINESS

Top 50 European electronics companies

1990 Rank	**Company** Location	Electronics sales ($ millions)	% change from prior year	Total sales ($ millions)	% change from prior year	5-year sales growth*	Net income ($ millions)	% change from prior year
1	**Siemens** Germany	$25,044	11.6%	$37,321	3.4%	3.0%	$985	5.8%
2	**Philips** Netherlands	23,846	-2.9	30,640	-2.6	-1.5	-2,487	-671.5
3	**Alcatel Alsthom** France	14,233	-8.2	26,456	.1	13.0	943	4.0
4	**Thomson** France	13,482	3.0	13,816	-1.9	4.7	-454	-597.8
5	**GEC plc** Britain	10,406	23.7	17,430	7.9	11.3	923	-7.6
6	**Robert Bosch** Germany	7,983	3.8	19,693	4.0	8.4	346	-10.6
7	**Olivetti** Italy	7,392	-1.9	7,543	.1	8.0	50	-70.2
8	**Ericsson** Sweden	7,118	18.0	7,720	15.6	7.1	583	87.2
9	**Groupe Bull** France	6,351	5.7	6,351	5.7	16.5	-1,247	NM
10	**Nokia** Finland	4,396	15.8	5,780	-2.9	15.0	90	25.5
11	**STC** Britain	4,078	-11.9	4,078	-11.9	2.8	96	-69.3
12	**IRI** Italy	3,834	10.2	61,391	10.2	7.8	925	26.5
13	**British Telecom** Britain	3,618	14.2	24,180	6.8	9.6	3,824	37.8
14	**Asea Brown Boveri** Switzerland	3,500	30.6	26,688	29.8	NA	590	.2
15	**AEG** Germany	3,257	1.2	8,137	7.4	3.9	-127	-174.5
16	**Grundig** Germany	2,887	20.0	2,887	20.0	9.3	121	29.1
17	**Bayer** Germany	2,647	19.0	25,769	-3.8	-1.9	1,178	-10.1
18	**Fiat** Italy	2,504	30.5	47,752	10.0	15.7	1,346	-51.0
19	**Ascom** Switzerland	2,128	11.6	2,128	11.6	NA	37	2.6
20	**Racal Electronics** Britain	2,022	-4.8	3,831	5.6	10.5	200	-7.1
21	**Matra** France	2,000	7.9	4,471	10.2	10.4	111	0.2
22	**Memorex Telex** Netherlands	1,870	-5.7	1,870	-5.7	19.2	-274	NM
23	**Mannesmann** Germany	1,772	14.2	14,816	7.2	5.2	294	-5.9
24	**Cap Gemini** France	1,683	30.1	1,683	30.1	32.8	114	19.0
25	**Schlumberger** Netherlands Antilles	1,580	5.3	5,306	13.2	-1.0	570	35.8
26	**SGS-Thomson Microelectronics** Netherlands	1,350	13.5	1,350	13.5	NA	-97	NM
27	**Oce-van der Grinten** Netherlands	1,265	9.1	1,265	9.1	3.4	47	1.2
28	**British Aerospace** Britain	1,234	19.2	18,721	16.0	31.4	462	11.6
29	**Thorn EMI** Britain	1,162	5.4	6,728	-1.5	2.0	306	-18.0
30	**Ciba-Geigy** Switzerland	1,023	-18.6	14,175	-4.4	1.6	743	-33.7
31	**Leica** Britain	993	301.8	993	301.8	56.4	2	-81.3
32	**Amstrad** Britain	939	-7.8	939	-7.8	33.5	56	-32.8
33	**Ferranti International** Britain	842	-42.4	842	-42.4	-5.1	-186	NM
34	**Smith Industries** Britain	841	-6.7	1,103	-4.5	11.9	131	8.5
35	**Nobel Industries** Sweden	823	26.5	4,459	19.5	NA	199	-14.6
36	**Lucas Industries** Britain	820	19.6	3,654	6.8	7.0	238	1.3
37	**Lex Service** Britain	806	-12.3	3,188	-10.3	11.5	9	-87.0
38	**BICC** Britain	764	0.0	6,909	2.6	13.0	195	-5.2
39	**Swedish Telecom** Sweden	743	NA	5,307	15.4	NA	31	-8.9
40	**Dassault** France	736	-2.6	736	-2.6	8.4	-8	-132.4
41	**BASF** Germany	718	2.5	28,851	-2.1	1.0	685	-45.0
42	**Oerlikon-Buhrle** Switzerland	604	-6.7	3,370	-1.3	-0.7	-66	NM
43	**Siebe** Britain	551	32.2	2,722	7.9	31.9	164	-16.2
44	**Cable and Wireless** Britain	542	-4.3	4,766	11.9	17.6	616	2.3
45	**Sema** Britain	497	NA	667	28.1	NA	17	-8.2
46	**Electrocomponents** Britain	493	3.1	764	5.3	15.8	66	-5.1
47	**Hoechst** Germany	473	-31.6	27,761	-2.3	1.0	1,050	-20.4
48	**SD-Scicon** Britain	456	-10.2	456	-10.3	NA	-41	NM
49	**Unitech** Britain	452	8.1	470	8.3	7.3	20	2.3
50	**Krupp** Germany	436	-6.3	9.635	-12.8	NA	134	NM

Electronics sales: Either a published figure or an ELECTRONIC BUSINESS estimate of the revenue earned by each company from sales of electronics products and services

* compounded average annual growth rate (% per year)

1990 net income % of sales	Return on investment	Debt to capital	Sales per employee	R&D % of sales	Capital expenditures % of sales	Foreign sales % of sales	Sales outside Europe % of sales	Fiscal year ended
2.6%	7.7%	18.8%	$100,057	11.0%	6.9%	55.0%	25.0%	9/90
-8.1	-14.5	57.7	112,315	7.9	5.1	93.5	39.1	12/90
3.6	6.0	44.3	128,740	8.4	4.9	62.6	21.8	12/90
-3.3	-5.6	54.4	131,007	6.0	5.6	70.3	45.3	12/90
5.3	15.6	15.3	147,054	4.6	2.7	58.7	33.0	3/91
1.8	6.7	21.0	109,628	6.4	8.8	51.0	16.8	12/90
0.7	0.7	62.1	140,515	5.2	4.6	63.4	18.5	12/90
7.5	15.7	24.0	109,911	10.7	7.5	82.0	41.0	12/90
-19.6	-59.7	109.3	142,790	8.6	6.5	NA	30.3	12/90
1.6	2.1	51.5	154,799	5.3	4.8	55.3	15.8	12/90
2.4	5.4	1.8	121,468	11.3	4.2	31.4	17.9	12/90
1.5	NA	NA	146,170	NA	NA	NA	NA	12/90
15.8	13.2	32.3	90,427	1.8	21.0	NA	NA	3/91
2.2	5.2	62.5	124,041	7.2	3.6	96.0	42.9	12/90
-1.6	-2.2	77.7	105,742	5.9	5.3	44.0	22.2	12/90
4.2	19.1	2.1	132,754	3.4	5.7	47.9	2.7	3/91
4.6	9.1	24.1	150,697	6.6	8.9	79.5	40.2	12/90
2.8	4.0	58.7	157,473	3.9	7.4	43.6	9.0	12/90
1.8	3.0	40.3	131,840	8.3	7.5	41.9	10.0	12/90
5.2	7.5	36.1	99,619	4.6	10.8	50.0	34.0	3/91
2.5	5.2	56.6	227,972	2.1	NA	45.2	NA	12/90
-14.7	-28.3	134.7	219,994	2.6	1.4	98.4	56.3	3/91
2.0	7.0	9.5	118,132	2.9	5.4	59.8	27.3	12/90
6.8	8.4	65.9	102,062	NA	NA	57.8	13.0	12/90
10.7	14.1	19.7	106,124	7.0	12.7	87.3	59.7	12/90
-7.2	-6.9	65.0	63,380	16.1	19.3	NA	38.6	12/90
3.7	5.1	43.3	112,281	6.9	15.6	90.2	18.3	11/90
2.5	6.5	28.7	146,373	2.1	7.9	65.2	42.0	12/90
4.5	11.6	37.5	116,145	3.3	13.4	54.3	27.3	3/91
5.2	5.1	22.3	150,570	10.4	10.4	98.1	55.0	12/90
0.2	0.4	63.9	100,548	7.5	4.8	NA	38.1	3/91
5.9	10.6	4.1	706,881	NA	2.1	56.5	7.8	6/90
-22.1	-47.8	46.8	46,333	1.7	2.3	39.7	35.6	3/91
11.9	23.1	13.3	82,010	16.0	3.5	47.4	55.6	7/90
4.5	4.8	73.6	167,303	NA	9.2	70.4	20.6	12/90
6.5	11.8	32.8	63,661	4.4	6.1	81.1	41.6	7/90
0.3	1.6	33.4	399,239	NA	1.9	NA	18.5	12/90
2.8	12.1	27.1	155,691	0.6	2.6	50.0	39.6	12/90
0.6	0.6	39.1	110,621	3.8	32.1	NA	NA	12/90
-1.1	-5.6	5.9	169,831	7.0	4.6	26.2	NA	12/90
2.4	6.2	19.0	215,217	4.4	9.6	65.8	32.8	12/90
-1.9	-2.1	54.9	127,481	4.4	7.9	NA	NA	12/90
6.0	6.6	53.6	83,108	3.7	3.4	89.8	61.3	3/91
12.9	9.9	19.6	120,894	NA	31.8	NA	67.5	3/91
2.5	10.9	40.9	88,659	3.4	4.1	67.0	1.5	12/90
8.6	24.4	26.3	185,927	NA	5.5	27.4	12.9	3/91
3.8	8.8	33.5	160,571	6.0	7.6	74.6	38.1	12/90
-9.0	-40.8	40.8	96,175	1.0	10.8	56.1	10.6	12/90
4.2	7.8	61.3	79,372	4.3	5.4	80.0	55.0	5/90
1.4	7.6	62.5	159,630	1.5	4.6	49.9	29.2	12/90

All figures shown are based on the latest available completed fiscal year thus a variety of accounting periods are represented. Similarly, the electronics sales and other financial information has been converted to dollars using an exchange rate that consists of the average rate during each company's fiscal year

NA = not available
NM = not meaningful

EXECUTIVE

COMPENSATION

How much more ($) can they take?

Who made the most in 1990, who lost the most, and when in the world will it ever end?

By Quang Bao

The men at the top of the electronics industry made more money than ever last year. An ELECTRONIC BUSINESS survey puts the average pay for the 100 top-paid executives at $998,582 in 1990, $108,317 more than the 1989 average. Membership in last year's million-dollar club rose to 34, up from 20 in 1989.

To understand how fat the paychecks have become for top electronics managers, the executive at the bottom of this year's list would have ranked 13th on our 1983 list. Since 1985, in fact, the compounded average annual growth rate for electronics executives' salaries has run at 12.4%, compared with only 6.2% for electronics sales.

Interestingly, no women appear in this year's top 100. The highest-paid woman on the survey was Carole F. St. Mark from Pitney Bowes. Her $454,457 landed her at the number-180 slot.

The two stars of the survey are Bernard L. Schwartz, 64, CEO of Loral Corporation, and John Sculley, 51, CEO of Apple Computer. Loral modified Schwartz's incentive compensation, netting him $1.3 million; add to that his increased base pay of $785,000 and a bonus package worth over $1 million, and Schwartz leads the pack with a total of $3.2 million. Schwartz is the first executive to break the $3 million mark since we've been tracking executive compensation. Sculley's earnings ($2.2 million this year) places him year after year near the top of the list. He has graced the top spot in our survey five times during the nine years we've been conducting the survey.

The 1990 list also boasts 26 new executives. That may be due in part to last year's overall sales increase among the industry's top 200 companies (see ELECTRONIC BUSINESS, July 22, 1991), which translates into more money for managers whose compensation hinges on company performance. "What a company makes should be a strong indicator of what their executives make," says James Foushee of The Foushee Group Inc., a compensation consulting firm in Burlingame, Calif.

One company that paid according to performance was Conner Peripherals, where sales increased from $257 million in 1988 to $1.3 billion in 1990. During the same period, the salaries of the top five executives almost doubled, putting them all on our list. IBM, Litton Industries, and Xerox also produced five executives for this year's list. Apple Computer, Compaq, and Honeywell each produced four, and several companies had three. Lotus president Jim Manzi, meanwhile, took a 12.5% cut last year, reflecting the company's meager 7.5% return on equity.

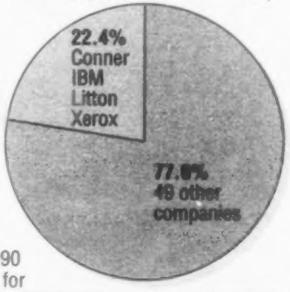
On the flip side is Richard W. Miller, chairman and CEO for Wang Laboratories, and Dean O. Morton, COO for Hewlett Packard. Wang's revenues decreased by 14.2%, dropping Miller's salary by 12.5% and bumping him out of the million dollar club. Despite a sales increase of 11%, HP's earnings also declined by 11%, sliding Morton out of the club with his 4% pay cut.

Executive salaries, however, aren't always tied to how the company is doing, notes Foushee. One exec who bucked the trend is Stewart Carrell, chairman of Diasonics. Carrell took the biggest pay cut (37.4%), despite the fact that net sales for Diasonics rose by 38% in 1990. Fourteen other execs on our list took a salary cut last year.

What makes these guys so valuable? There is no easy answer, notes Foushee, but one reason for the big bucks is the lack of salary standards. "You have young, talented people who start small companies and pay their executives according to what billion-dollar companies pay," explains Foushee,

Who's tops in executive pay?

(% of total salaries for 100 top-paid electronics execs)



Total 1990 salaries for top 100 = $99.9 million

Source: ELECTRONIC BUSINESS

Paycheck heroes, paycheck zeros

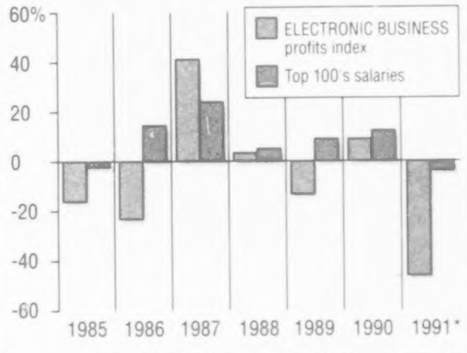
Industry experts may blast top-paid executives for making too much during sluggish times, but ELECTRONIC BUSINESS found that most executives earned it. Unlike executives' salaries in other industries, the paychecks of the executives in the electronics industry make sense. Profits—or lack of profits—do, in fact, drive pay.

George M. Scalise, chief executive for Maxtor, more than tripled his company's profits in 1990. Therefore, his salary tripled. Alan F. Shugart, chief executive of Seagate Technology, took his company's profits from a scant $349,000 in 1989 to $117 million in 1990. Needless to say, Shugart got a raise.

On the other hand, Applied Materials chief executive James Morgan's salary plunged to reflect the company's 23% shrinkage in sales and 119% in profits. AMD chairman W. J. Sanders took a 25% salary cut last year after his company swallowed a 216% decline in profits. ☐

Profits *do* drive executive pay

(annual % change)



*Forecast Source: ELECTRONIC BUSINESS and Cahners Economics

and since there is a limited number of managers to run electronics companies, qualified executives feel justified in demanding bigger bucks. "They basically write their own paychecks based on what other top guys are making," he says. "The industry isn't mature enough to know what fair compensation is."

Inclusion in this high-profile club is becoming more of a problem than a privilege, says Foushee. The reason is that employees perceive their bosses as caring more about making money for themselves than about workers and their companies. The perception is so widespread, in fact, that Tim Schwartz of Western Management Group, a research and survey firm in Los Gatos, Calif., dismisses the million-dollar execs as "a club full of ninnies."

Some experts predict that salaries are due to level off. Executive compensation in companies with 500 employees or less is already decelerating, according to Roger Stabile, director of surveys for the American Electronics Association—not just because of the recession, but "because people are becoming more sensitive and more responsive to criticism from managers who have to lay off workers."

Schwartz says that future compensation packages should have a profitability factor that needs to be taken into account. "A company should tell an executive that his next pay raise will be effective when he is," he says.

Michael Cleary of Joiner Associates in Madison, WI argues that executives should be subjected to the same kind of evaluations as their employees. "If you base employee bonuses on meeting a deadline or decreasing the number of rejects, then why can't you set a mark for executives to reach?" he asks. "The message you're sending out in the end is that I'm okay; you're not okay. I'm okay but you need standards."

Foushee also predicts a "salary revolution" in the next two or three years, suggesting that top dogs could set an example for other executives by taking large pay cuts to boost company morale. "I see the board of directors getting more involved with excess pay and giving a much more prudent review of how they are going to reward their executives," says Foushee. Another method to determine salaries is to hire a professional arbitrator to lay out a fair compensation plan, a tack that companies such as Apple and Mass Par Computer have already taken.

Electronics executives' salaries have a long way to go before they reach the heights of their peers in other industries. Sun Microsystems president Scott McNealy, for example, is 12th on our list but appears on *Forbes's* "lowest paid" list. Apple's Sculley, in fact, is the only electronics executive to make it near the top of *Forbes's* best-paid executives survey. As salaries are increasingly publicized, moreover, the ante will be raised as executives performing the same work in other companies wonder why they aren't being paid the same.

To Schwartz of the Western Management Group, though, it doesn't much matter how well an executive does his or her job. No one can justify making that much money. "It's a crime what they're paying these guys," he says. "Somehow, it's got to end." ☐

Compensation data for electronics' 100 top-paid executives, taken from the companies' latest proxy statements, includes salaries and bonuses but not stock options. The survey was limited to publicly held companies in which electronics accounts for 50% or more of total sales.

EXECUTIVE COMPENSATION

Rank	Executive/age	1990 cash compensation	% change from 1989	Company	Position
1	**Bernard L. Schwartz**/64	$3,212,635	84.4%	Loral	Chairman, CEO
2	**Joseph R. Canion**/46	2,327,160	10.0	Compaq Computer	President, CEO
3	**John Sculley**/51	2,198,866	-2.3	Apple Computer	Chairman, CEO
4	**John F. Akers**/56	2,028,400	42.8	IBM	Chairman
5	**Charles B. Wang**/45	1,956,512	9.1	Computer Associates	Chairman, CEO
6	**Anthony W. Wang**/47	1,683,512	10.7	Computer Associates	President, COO
7	**Lawrence J. Ellison**/46	1,599,756	-7.8	Oracle	President, CEO
8	**Frank C. Lanza**/58	1,568,333	70.6	Loral	President, COO
9	**John A. Young**/58	1,498,360	-5.4	Hewlett-Packard	President, CEO
10	**David T. Mitchell**/48	1,485,553	69.9	Seagate Technology	President, COO
11	**James J. Renier**/61	1,469,323	7.6	Honeywell	Chairman, CEO
12	**Scott G. McNealy**/35	1,406,600	80.0	Sun Microsystems	Chairman, President & CEO
13	**Alan F. Shugart**/59	1,406,273	84.3	Seagate Technology	Chairman, CEO
14	**Finis F. Conner**/47	1,405,158	99.6	Conner Peripherals	Chairman, CEO
15	**Thomas L. Phillips**/66	1,340,002	NA	Raytheon	Chairman, CEO
16	**Orion L. Hoch**/61	1,336,099	NA	Litton Industries	President, CEO, Director
17	**Eckhare Pfeiffer**/49	1,335,612	34.8	Compaq Computer	President, Europe & International
18	**Jack D. Kuehler**/58	1,307,760	42.4	IBM	President
19	**Michael H. Spindler**/48	1,303,433	60.7	Apple Computer	President, COO
20	**David T. Kearns**/60	1,297,702	-2.7	Xerox	Chairman, CEO
21	**William J. Almon**/58	1,277,591	111.7	Conner Peripherals	President, COO
22	**Jean-Louis Gassee***	1,230,173	51.7	Apple Computer	Sr. VP
23	**Ryal R. Poppa**/57	1,207,574	30.5	Storage Technology	Chairman, President & CEO
24	**Paul A. Allaire**/52	1,197,294	30.7	Xerox	President
25	**Charles E. Exley Jr.**/61	1,194,995	2.5	NCR	Chairman, CEO
26	**Douglas K. Mahon**/49	1,186,987	48.2	Seagate Technology	Executive VP, Chief Technical Officer
27	**Michael R. Hallman**	1,169,393	NA	Microsoft	President, COO
28	**J. J. Adorjan**/52	1,144,807	NA	ESCO	Chairman, CEO
29	**Leon Machiz**/66	1,142,736	23.4	Avnet	Chairman, CEO
30	**John T. Hartley**/60	1,109,578	3.1	Harris	Chairman, President, CEO
31	**George M. Scalise**/56	1,081,305	217.2	Maxtor	President, CEO
32	**Joseph L. Parkinson**/45	1,053,622	1.8	Micron Technology	Chairman, CEO
33	**Ian Diery**	1,049,419	NA	Apple Computer	Sr. VP, Pres. Apple Pacific
34	**John C. Lewis**/55	1,031,148	19.2	Amdahl	Chairman, CEO
35	**Kenneth H. Olsen**/64	982,452	3.5	Digital Equipment	President, Director
36	**John P. Squires**/43	980,881	100.9	Conner Peripherals	Executive VP
37	**Wesley E. Cantrell**/56	976,076	NA	Harris	Pres. Lanier Worldwide
38	**Geoffrey W. Squire**	971,827	108.6	Oracle	Exec. VP, Pres. Worldwide Distribution
39	**Frank A. Metz Jr.**/57	970,607	43.2	IBM	Senior VP
40	**Dean O. Morton**/58	962,728	-4.0	Hewlett-Packard	Executive VP, COO, Director
41	**E. Joseph Zemke**/50	933,540	62.5	Amdahl	President, COO, Director
42	**George M. Fisher**/50	931,347	19.9	Motorola	CEO, President
43	**C. Michael Armstrong**	929,100	36.6	IBM	Senior VP
44	**T. R. Lautenbach**	929,100	36.6	IBM	Senior VP
45	**Dennis J. Picard**/58	925,002	NA	Raytheon	President, Director
46	**James L. Donald**/59	909,917	15.6	DSC Communications	Chairman, President, CEO
47	**Michael Swavely**/37	902,134	19.3	Compaq Computer	President, North America
48	**Lawrence P[illegible]man**/52	900,000	36.8	Control Data	President, CEO
49	**E. Gene Keiffer**/61	884,152	17.5	E-Systems	Chairman, CEO
50	**Richard W. Miller**/49	875,487	-12.5	Wang Laboratories	Chairman, President, CEO

* Retired

EXECUTIVE COMPENSATION

Rank	Executive/age	1990 cash compensation	% change from 1989	Company	Position
51	**John V. Roach**/51	873,749	-10.0	Tandy	Chairman, President, CEO
52	**Jim P. Manzi**/39	867,545	-12.5	Lotus	Chairman, President
53	**Jerome Swartz**/50	863,150	.0	Symbol Technologies	Chairman, CEO
54	**William E. Johnson**	856,257	-2.1	Scientific-Atlanta	Vice Chairman, CEO
55	**Joseph T. Casey**/59	852,670	NA	Litton Industries	CFO, Director
56	**C. Scott Holt**/49	828,262	85.8	Conner Peripherals	Executive VP Sales & Marketing
57	**James M. Harris**/47	825,000	12.6	Compaq Computer	Sr. VP, Engineering
58	**Gary Stimac**/39	825,000	12.3	Compaq Computer	Sr. VP, Systems Engineering
59	**Christopher J. Steffen**/49	794,445	63.2	Honeywell	Executive VP, CFO
60	**Donald L. Waite**	792,110	66.6	Seagate Technology	Sr. VP, CFO
61	**Winston R. Wallin**/64	791,423	18.0	Medtronic	Chairman, President, CEO
62	**Bruce O. Beebe**/54	782,878	NA	Amdahl	Sr. VP, Product Operations
63	**J. Tracy O'Rourke**	782,192	NA	Varian Associates	Chairman, CEO
64	**George B. Harvey**/59	774,756	-10.2	Pitney Bowes	Chairman, President, CEO
65	**Wayland R. Hicks**	765,952	23.5	Xerox	Executive VP
66	**John F. Mitchell**/62	763,942	-9.7	Motorola	Vice Chairman
67	**Gary L. Tooker**/51	763,224	14.2	Motorola	President, COO
68	**Carl Neun**/47	756,761	NA	Conner Peripherals	Sr. VP
69	**Roland O. Peterson**	737,678	NA	Litton Industries	President, COO
70	**William C. Lowe**	735,236	38.4	Xerox	Executive VP
71	**Charles M. Clough**/62	730,000	NA	Wyle Laboratories	President, CEO
72	**Stuart B. Ross**	726,719	NA	Xerox	Executive VP
73	**Andrew S. Grove**/53	723,003	3.2	Intel	President, CEO
74	**Sidney Topol**/65	711,701	58.9	Scientific-Atlanta	Chairman
75	**Robert Galvin**/68	700,000	.0	Motorola	Chairman
76	**Horace G. McDonnell**/62	690,611	NA	Perkin-Elmer	Chairman, CEO
77	**A. Lowell Lawson**/53	680,813	14.8	E-Systems	President
78	**D. Larry Moore**/54	678,837	NA	Honeywell	Exec. VP, CEO
79	**Gilbert P. Williamson**/53	672,667	17.7	NCR	President
80	**Arnold Mazur**/47	667,961	NA	Computer Associates	Exec. VP
81	**Gordon E. Moore**/61	665,533	3.5	Intel	Chairman
82	**Philippe Kahn**/38	664,648	NA	Borland International	President, CEO
83	**Joe E. Chenoweth**	658,511	16.5	Honeywell	Sr. Corp. VP, International
84	**Thomas A. Vanderslice**/59	652,324	NA	M/A-Com	Chairman, CEO
85	**W. J. Sanders III**/54	651,167	-25.9	Advanced Micro Devices	Chairman, CEO
86	**Jeffrey L. Walker**	644,882	NA	Oracle	Exec. VP, CFO
87	**M. Howard Dingman Jr.**	643,947	NA	Litton Industries	Senior VP, Pres. Western Atlas Int'l
88	**Dennis M. Ohryn**	640,250	81.6	Sun Microsystems	VP Worldwide Field Operations
89	**Phillip W. Colburn**/62	637,500	NA	Allen Group	Chairman, CEO
90	**Winston H. Chen**/49	634,696	NA	Solectron	Pres., CEO
91	**Michael R. Bonsignore**/49	631,521	2.1	Honeywell	President, International
92	**Stewart Carrell**/57	625,262	-37.4	Diasonics	Chairman, CEO
93	**Michael P. DeBlasio**/52	623,041	17.0	Loral	Sr. VP Finance
94	**Jerome Swartz**/50	622,070	-27.9	Symbol Technologies	Chairman, CEO
95	**James C. Morgan**/52	613,346	-13.8	Applied Materials	Chairman, CEO
96	**Joseph B. Costello**/37	606,597	NA	Cadence Design Systems	President, CEO
97	**Joseph F. Caligiuri**	606,125	NA	Litton Industries	Executive VP
98	**Max E. Bleck**/63	605,004	NA	Raytheon	Pres. Beech Aircraft
99	**Richard C. Alberding**	604,959	-2.7	Hewlett-Packard	Executive VP
100	**Thomas D. Sege**/63	604,221	56.4	Varian Assoiates	Director, Chairman, CEO

* Retired